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AUTOMATION--THE THREAT AND THE PROMISE, THE ROLE OF THE COUNSELOR IN THE MANPOWER REVOLUTION.

BY- DIEBOLD, JOHN AND OTHERS
TWIN CITY VOCATIONAL GUIDANCE ASSN.

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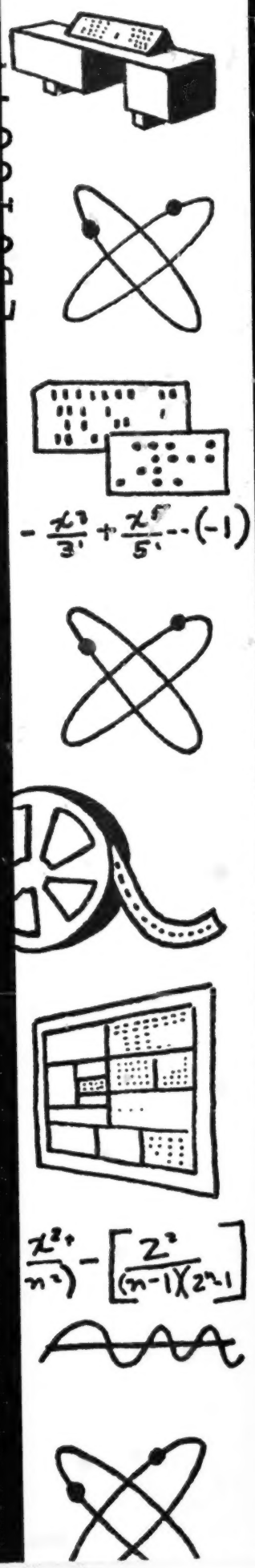
THREE OF THE PRESENTATIONS AT THE ASSOCIATION'S 1963 WORKSHOP, IN ADDITION TO A FOURTH PAPER COMMISSIONED TO ROUND OUT THE DISCUSSION, WERE SELECTED FOR PUBLICATION. THEY ARE CONCERNED WITH AUTOMATION AS A FORCE INFLUENCING WORK AND MANPOWER. THE PRESENTATIONS WERE (1) "IMPLICATIONS OF CYBERNETICS," BY JOHN DIEBOLD, IN WHICH THE AUTHOR DESCRIBES ACTUAL TECHNOLOGICAL CHANGES, SHOWS THAT TECHNOLOGY IS THE AGENT FOR SOCIAL CHANGE, AND RECOMMENDS GIVING HIGH LEVEL ATTENTION TO THE HUMAN AND SOCIAL PROBLEMS ASSOCIATED WITH TECHNOLOGY, (2) "LABOR'S VIEW OF AUTOMATION," BY CARL WINN, IN WHICH THE AUTHOR PROPOSED COLLECTIVE BARGAINING TO FACILITATE THE ORDERLY INTRODUCTION OF AUTOMATION AND PROVIDE STANDARDS AND PROCEDURES FOR THE DISTRIBUTION OF EMPLOYMENT OPPORTUNITIES AND AUTOMATION COSTS AND BENEFITS, AND A STABLE SOCIAL AND ECONOMIC STRUCTURE PROVIDING WORK FOR EVERYONE WHO WANTS TO WORK, (3) "SOCIAL EFFECTS OF AUTOMATION," BY EDWARD GROSS, IN WHICH IT IS RECOMMENDED THAT GUIDANCE COUNSELORS NOT ONLY COUNSEL INDIVIDUALS BUT SOCIETY ITSELF SO THAT THE ADVERSE SOCIAL AND PSYCHOLOGICAL EFFECTS OF AUTOMATION CAN BE MINIMIZED, AND (4) "TECHNOLOGICAL CHANGE AND VOCATIONAL COUNSELING," BY JOSEPH SAMLER, IN WHICH THE THREAT AND PROMISE OF TECHNOLOGICAL CHANGE, THE EMERGING LABOR FORCE, AND THE EMERGING COUNSELING PROBLEMS ARE DISCUSSED. THIS DOCUMENT IS AVAILABLE FOR $1.00 FROM NATIONAL VOCATIONAL GUIDANCE ASSOCIATION, 1605 NEW HAMPSHIRE AVENUE, N.W., WASHINGTON, D.C. 20009. (JM)

THE ROLE OF THE COUNSELOR IN THE MANPOWER REVOLUTION



AUTOMATION

the threat

and the promise

Twin City Vocational Guidance Association
Branch of
National Vocational Guidance Association
Division of
American Personnel and Guidance Association
1964

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AUTOMATION:
the threat and the promise

The Role of the Counselor in the Manpower Revolution .

Four papers

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Twin City Vocational Guidance Association

Branch of

National Vocational Guidance Association

Division of

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Washington, D. C.
1964

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Acknowledgment

The National Vocational Guidance Association has throughout its half century of professional growth and leadership been vitally concerned with the evolving future of work. Last year in commemoration of our Golden Anniversary we produced "Man In A World at Work" under the editorial guidance of Dr. Henry Borow.

We are exceedingly pleased to bring to counselors this timely capsule of one of the most permeating forces influencing change in not only the types of work performed, but the amount of manpower required to produce the goods and materials desired for abundant living.

The Association is deeply indebted to the authors for permission to reproduce their presentations; to members of the Twin Cities Vocational Guidance Association who sponsored the presentations in the spring of 1963; to William Palm, workshop chairman, Edward O. Swanson, then TCVGA president; and to the members of our Publications Committee who have handled the details involved in getting the materials ready for publication. We owe a special word of thanks to G. Dean Miller, the Publications Committee Chairman, and to Rose Scherini and Wesley Tennyson who assisted with the editorial work.

Kenneth B. Ashcraft, President,
National Vocational Guidance Association

Introduction

The Twin City Vocational Guidance Association, a Branch of the National Vocational Guidance Association since 1920 has held in recent years an annual workshop series on topics relevant to the role of work in the life of man. It has been the custom to invite prominent speakers from around the country to participate in a workshop and the majority of the association's budget goes to serve its members in this way.

The Twin City (Minneapolis-St. Paul Metropolitan area) group is most pleased that three presentations were selected to be published as papers by NVGA. It was felt that a fourth area, dealing with vocational counseling, was needed to compliment the areas of industrial sociology, labor, and automation covered by the workshop presenters. To this end Dr. Joseph Samler was invited to write the final paper.

It is hoped that these selected papers dealing with the various phases of automation and its effect upon man will stimulate interest on the part of counselors for what may be ahead in the, as yet, still dimly lighted future of work in the life of man.

G. D. M.
E. O. S.

Implications of Cybernetics

JOHN DIEBOLD

You may find in this series, because it is a very wide field, people are talking about the consequences of very dissimilar developments. Usually in one lecture people will talk about the consequences of automatic machine tools; in another lecture they'll talk about the consequences of electronic computers. But these are all in the area of automation. One of the issues I'm going to concern myself with during this initial presentation is the problem of what is really the whole phenomenon—What's happening? What is the nature of the phenomenon? What is the development of automation?—There'll then be at least a chance for you to pin people down a little and to know whether they're talking about one aspect of the field, or all of the field. It's an area of horrible semantic problems. What normally happens is that people talk immediately about the consequences of their idea of what's happening. As you spend more and more time with them you find that they may be thinking about one development, and a lot of conclusions are being tacked to other popular fields.

So the things I want to discuss include: first, the whole nature of this development, and, second, some conclusions and observations about its consequences. What are the consequences, particularly in terms of the problems of trying to give guidance to people and trying to gain an understanding of what is happening, of how the world is changing, and how the nature of jobs and occupations will change as a result of the development of automation? There is an interesting example of the semantics problem in this country. Virtually nobody here uses the term "cybernetics;" but overseas, particularly in the Soviet Block, *cybernetics* is the principal term, and automation is one area in the field of cybernetics. Jerome Wiesner and I set up a cybernetics session at the United Nations Science Conference in Geneva; and to be intelligible to the block countries—the Satellite and Soviet group—we had to use the term cybernetics because we were talking about things other than purely the factory use of the technology. If you did that in this country most people, even in the technical community, would not recognize the terminology. It's a bad semantic problem, and you'll see some of it as we go on.

Most important technological developments, as is true of other types of developments, can be traced back historically to very early roots. This is certainly true of automation. You can find examples of the technology being applied in Roman times in the forms of flow control valves and very simple automatic systems. More complex systems were used by

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the Chinese in the 11th and 12th centuries. Systems were used by the Dutch in the 16th century with a feedback system to keep the windmills turned into the wind regardless of a change in direction. More complicated examples were used in the steering engines of ships that the British built in the 19th century. In the early part of this century, thermostats were installed that had automatic temperature control (something that's not unfamiliar to people in Minneapolis, since this type of equipment originated here).

But unlike some developments with a gradual evolution of the technology, the real roots of this field are in the Second World War. Early traces of computers and people who designed computers are found in the early part of the last century. There are examples of almost any portion of this technology in a very crude form, or in someone's notes or ideas, at a very early time. The whole development itself, however, comes almost from a standing start at the beginning of World War II; and it is not overstating the case to say that the real spring from which this river has been flowing is World War II. I'd like to give you an indication of why this happened, of what happened technically, what is going on right now, and what is likely to happen in the next few years.

A New Ability to Handle Information by Machines

My discussion will be concerned with the technology. I'm going to try not to make it a description of technology. The one point I want to make is this: the only way you can draw a proper conclusion about this whole development is to realize that it is a basic insight into handling information. It is an ability to build machine systems to handle information to do anything we want. We have produced some of these so far — the computer, for example. We have produced new families of machines. But to draw conclusions as to what's going to happen in the future, one can't look at what we have already produced. The basic point is that suddenly there is a new found ability to handle information by machine systems. This is really what I'll be talking about. This is the only point that you have to look at. The whole development is an ability which we didn't have thirty years ago—the ability to build information systems for handling information of a wide variety.

At the outbreak of the war, overnight the traditional methods of directing guns became obsolete because the speed and the maneuverability of the target in aircraft changed. The methods that 150 years before had been developed for directing the guns—very involved tables and very complicated methods suddenly became obsolete. The target moved so rapidly, we couldn't apply them. So a big block of scientific manpower in England and this country attacked the problem of how to direct guns and how to get the projectile to where the airplane is going to be and then explode it. Out of a vast amount of scientific work

came radar for determining where the target would be; the electronic computer for handling the data the radar produced; stable servo-mechanism systems that can direct and physically move the gun, position it rapidly and very, very accurately, and a host of techniques associated with building control systems of this kind.

But most important, out of all of this work came a theory of information, a whole group of insights into the nature of information. What is information? What is conveyed when you speak a sentence? We came out of the War with a theory of information. The linking of this theory of information with technology allowed us to start to build information systems—machine systems for handling information for any purpose.

The first thing built was the computer in 1945. We spent the next five years building different models and different versions of it. By 1950 we had maybe 100-150 computers in this country. These were built at Universities, at research establishments, and by the military. They were all different. If you had 100 computers, you just about had 100 different kinds of computers. During that period we worked on circuitry and logical design, and we experimented with types of components—with what should go into a computer and with what a computer should be like. About 1950, we started to standardize machines and some of the equipment; manufacturers began putting out computers on a commercial basis. About 1950-55, the machines were used primarily for engineering and scientific applications; so we began producing them in larger quantities. In 1955, we started applying the machines to business applications and we also continued to apply them to scientific and engineering uses. The latter half of the 1950's we began on a very intensive basis to use them for business purposes. Today, we have orders for nearly as many computers as were built in the sixteen or seventeen years since the machine was invented—the curve is going up at a sharp rate. We are hitting a very fast stride in the production of these machines. Outside this country you see the same kind of a curve but you must slip the time scale a few years. *They're* just beginning to get to this point in Western Europe and they're beginning to order a lot of computers and apply them very heavily.

The Computer is Only One of a New Family of Machines

One of my main points is that the computer, as important as it is, is only *one* new family of machines. It's a very important family of machines that's being used in many ways — and we'll be discussing some of these. But it is only *one* family of machines! We are starting to throw off other brand new families of machines that never existed before, but which will be applied to do some of the things we do now. Mostly, they will be applied to do things we don't do at the present time, or that

we do very badly. These new families of machines will continue to be thrown off.

The important thing in talking about the social consequences of automation—the consequences in terms of people and of careers and of opportunities—is to focus on the potentialities. I think the basic mistake that's made is that people look at what's happened so far. They look at the computer or they look at the tape controlled machine tools. They look at one thing that's come out of this technology or at several of them, whatever exists today, and they say, "Well, that's automation." Then they draw conclusions as to how far the computer is going and what's going to happen, and they'll draw up a series of what may be perfectly correct conclusions. But they're missing the fact that what's basically important is the technology that's going on and is throwing off these new families of machines.

Let me describe a couple of these new machine families that are being developed and try to make my point a little better. The computer is the most dramatic example so far. The same technology has been applied in the field of numerical machine tool control—of tape control of machine tools. It's a much smaller development but it's beginning to be quite important in the factory area. The gears in some automatic machine tools, highly automatic ones, served as controls. And these machines were automatic because they stored information about what to do in a mechanical form. They stored cams and levers and gears, and if you wanted the machine to produce a given product automatically you could build the machine that would produce it. But, if you then wanted to change and produce something else you'd either scrap the machine or rebuild it. If you have a versatile automatic machine you might change it from producing this type of cup to another type of cup. You might close it down for a day and change the instructions by changing the gears, the levers, and the cams that kept all the information—the memory. It was mechanical.

The same ability in information technology allows us to build a computer which stores the information for the machine in a different form. We store it on magnetic tape so that when we want the machine to build a given part, we put one reel of tape into the machine. When we want it to build another part, we put another reel of tape in it. All of the information, the memory, the storage of what the machine should do, the instructions to it, were no longer stored in the form of levers, cams, and gears that you had to physically bolt on. The instructions are all on a roll of tape. You take one roll of tape rather than another and put it on the machine and the machine will go through a different cycle of operations automatically. This is a very important innovation.

Most of the products in our economy are produced in very short runs. We think of our factories as huge mass-production factories where

we produce about 6-million automobiles annually. Actually, most products, something on the order of 80% of the hard goods output in the country, are produced in runs of twenty-five identical units or less. Mostly these are short runs of different products. Previously, to have an automatic machine in these areas had been logically impossible. You could use automatic machines only for component parts which were similar and where you could produce hundreds of thousands of them. Now you can have a machine that will take tape instructions and you can produce one or two parts economically. Then you can store the tape on a shelf. The next year you can produce a few more parts and you can do it automatically. It also means, for example, that if you have a ship's engine that gets into trouble in Hong Kong you don't send the new part to the man any longer. If it's a complicated big part you send a tape and they put it on a machine tool in Hong Kong. They produce the part there rather than waiting for it to be shipped to them. So you have quite different patterns of supply growing up. You ship the factory to the user, rather than shipping the product; and you get a variety of changes in industry as a result.

This is called numerical machine tool control. At the very beginning, we had maybe forty different systems and maybe one hundred applications of them in the country. Their use grew slowly at first. Now it will grow quite rapidly. There are maybe 4,000* systems in the country at the present time; and we believe that by 1970, almost half the dollar value of new machine tools that are shipped in America will be taped from full machine tools.

I can't go into the consequences of each of these changes independently, but the example of shipping the tape rather than the parts cuts down enormously on inventory in a company. Previously, if you didn't have automatic machines, you figured out how many parts you should make, how long a run you should have in order to have an optimum cost, so you didn't have to stop the machine for a day or two to change it. This would be expensive so you didn't just produce the twenty parts a month you needed; you might produce six months' requirements. And you'd balance off the cost of keeping the parts in inventory, the possibilities of their obsolesence, and the cost of the money and the interest on it, and the cost for the time you had to shut the machine down to change it.

You don't do that with the numeric machine tool. You produce what you need at the time, and store the tape. You tie up much less in inventory and you run much less risk of obsolete parts. There are a lot of other consequences for business. For example, it is getting to the point where you may not even have to ship the tape if it is needed rapidly—you can telephone it. If you have a ship in trouble in San Diego, you can put the tape into the telephone system and get the tape to San Diego a few seconds later with the instructions for the machine tools. If you have a

*End of 1964, 5,000.

national emergency in which you need a lot of factories to produce the same aircraft parts quickly, all your information is on the tapes and you duplicate one hundred tapes and send these to different parts of the world. Otherwise this would take months of shipping.

There are all kinds of interesting consequences in each facet of this and you get very different kinds of things happening with numeric machine tools. For example, you don't just control machine tools that were designed for people to operate. We're starting to build machine tools that are designed only for tape control so that you may do many more things at once. A human can coordinate only two motions at one time, has a very long reaction time, very limited sensitivity, and an ability to pay attention to only a few things happening at once. If you're using tape you can have many, many different things going on at one time. The machine will look very different. It won't be designed around demands; it will be designed around the function of doing the job. It will be a very different kind of machine tool.

One of the big problems now is that the industry that builds machine tools is a very old industry which was designed to build single-purpose machines. Suddenly you have an ability to put all these things together to produce machines which will produce the entire part. In the past one company made one part, another company made another part; but this kind of industry structure doesn't fit the technology. Thus there is turmoil in the machine tool industry.

Process Control is Another New Field for Automation

The third area of automation that is already well under way is Process Control. This is the use of machine systems—information systems—to control oil refineries, chemical plants, pulp refineries (called pulp plants or paper plants), and power plants to generate power for a city. These are factories that don't have discrete products but that have a continuous flow of a product, whether it's steam producing electricity, a chemical process, or oil through a refinery. This is an area that on the face looks as though it is very highly automated already. You immediately think of an oil refinery and great rows of instruments with one or two men in a control booth running the factory. Popular magazine articles about automation imply that we would make the iron foundry something like the oil refinery. There would be just three or four men, plus a maintenance man, running the iron foundry.

The refineries appear highly automated since they don't have to use many people. But actually it is an area where the greatest change is going on technologically. All the instruments that Honeywell and others build are essentially regulators that regulate individual variables. They regulate the temperature like a thermostat in a room, or they regulate a rate of flow or a level of a liquid. A refinery may have a couple of thousands of variables that are being controlled, and they have very

good regulators for controlling each individual variable. But by and large each regulator controls only one variable. Thus a couple of thousand regulators may be required in a single room. In an extreme case, at one of the atomic energy plants, there are so many instruments that the man running the plant uses field glasses to read them. It is a huge, three-level, round room with three different levels of control panels and a desk in the middle with two operators. They use field glasses to read the instruments so they can record their data.

With many, many instruments each controlling the temperature, or the level, or the rate of flow of a particular variable, the busy operator had to relate all these. Any change affects everything else. He had to try to figure out what crude oil would come in at the oil refineries. Today you get a tank or load from Oklahoma. Oklahoma crude oil is totally different from Venezuelan crude. All these things require changes and what you do, in fact, is to make an approximation of the effect of the changes. With all the science, and all very fine-looking instruments, you do far less than an optimum job. Some tests have been run on the record (each of these instruments keeps a record of what happens). When they reconstruct the operation of the refinery using a computer to build a model of how it actually worked over a 24-hour period they have found that the refinery worked at optimum something like six minutes. The man wasn't able to do better and it's understandable. If you try to balance just three of these things, it's difficult; with hundreds of instruments, it's impossible!

In a paper plant, for example, you put a bleach tower in a pulp mill where you have pulp coming through. You want it to produce a particular kind of paper, so you bleach the pulp to a certain level of color. The bleach tower may have a quarter of a million dollars worth of instruments. It will have maybe three separate big tanks that the pulp is passed through along with water and chlorine and different chemicals for producing the color change. The pulp will come along as a mash. You make your changes in your shade by changing the combinations of the chemicals, the rate of flow of the water, the rate of flow of the pulp, and the temperature and the mixture of these things. In a well-run bleach tower you keep a log book, logging entries every thirty minutes. You may take a sample every thirty minutes or at each stage and a man runs it down to the laboratory and it is analyzed. It comes back with directions about what to do. At best, it takes twenty minutes to get the sample back. But this gives you an analysis of what the situation was twenty minutes ago. In the last twenty minutes some of the logs that went through the chipping machine may be from trees that grew on the shady side of the hill instead of the sunny side of the hill. Their chemistry is totally different so you are correcting a situation that no longer exists; and this can go on and on. Most of our very efficient factories run like this. These are the process plants that are highly instrumented, with millions of dollars worth of engineered instruments.

The process control is a natural for this type of technology because you can build systems to take account of all variables and very quickly analyze the relationships. The busy operator can't do the job of trying to balance all the consequences. All he can do is consider a few key ones. And the variables will differ—one crew uses one setting and the next crew that comes on uses a totally different setting. At a paper mill, for example, you have maybe fourteen men on one of these big block-long machines. When the crew changes the new foreman will change all the readings because he uses a different key—a different rule of thumb. He gets out the same paper, but he does it differently, and he changes the previous man's readings. This is because each operator can only control a small number of variables, and each one has a different feeling for which ones to work with. They're very skilled artists so that they do a pretty good job.

We're starting to build information systems that encompass the entire plant, that pick up the information at many points, and then analyze it. You can account for a change in the chemistry of the log or pulp that comes in; the system is able to take account of the consequences of a large number of alternate changes and to work out the best change and the best combination of settings, and then make them. Thus we are building information systems for process control plants. We have 150 or 200 of these at the present time.* Some of them are very sophisticated; most a little less sophisticated. Toward the end of the 1960's the usual power plant for a city is going to be a completely automated process control system—for starting up the generators, for operating them, for cutting them down, and for the entire normal operation of the power plant. This will be true of process control plants in chemicals, in paper pulp and paper; and it's already partly true in the atomic energy field. It will gradually be a very important development. It is not done to save labor but to try to get a better yield on the operating equipment and on the raw materials.

These are three new families of machines that encompass a large part of what's called automation today. We have some new families of machines in the laboratory, some of these are starting to reach the market. In the area of information retrieval machines, the first commercial models are being marketed this year. These machines are, in effect, libraries. They store large quantities of information and retrieve it very rapidly. To some extent computers have been used in this area. Some general purpose computers have been used for an information retrieval problem, by putting a lot of information into them and trying to get back certain kinds of information very rapidly, but they are very crude at this. In the same way computers have been used as translating machines —I'll come to this.

*End of 1964 more than 400.

We are getting a whole new breed of machine—quite a new kind of machine which is partly electronic and heavily optical, mechanical, and electromechanical. The origin of these is primarily in the espionage field. Primarily they've come out of the field of intelligence work where you need huge amounts of information accessible very quickly. For example, if you take aerial photographs every day of a very large land mass, you are deluged with photographs and have the problem of trying to find specific photographs very quickly. You can't go through the process of checking them by number and doing it by hand. You want a means that will produce a photograph and maybe throw it on a screen, or compare one photograph with another, or produce them in hard copy in printed form for you instantaneously. Your problem is one of simply keeping track of large quantities of literature for an intelligence or espionage problem. You need enormous amounts of literature, and you want to get to specific pieces very rapidly.

This is the problem in a library: there are many books and many documents, or a certain page or article or section of it, to be retrieved. Machines first developed for intelligence purposes are now in the process of being produced on a commercial basis to replace libraries. They're putting library catalogues themselves into information retrieval systems so that you can get a series of titles very rapidly. With some of the memory and search systems that are being built, you can give the machine the idea and it does your browsing for you. You can say you're interested in a certain subject, but you don't know the title; the machine would throw out titles related to that subject. In the more advanced systems, still in the laboratory stage, you can give the machine the idea—say you're interested in a certain concept and want to know where it occurs—the system will go through and will throw out the titles that are related. Some of these systems will print out the manuscript. You store the material on film. But the film is on chips of film which are very highly reduced so that on a single piece this size you may have four or five books. You have these mounted mechanically so that you are able to physically retrieve specific plates. The content is either printed or projected. You could print them with a xerographic process or any of a variety of processes. We are starting to use such systems for highly technical libraries—specific pieces of literature or specific fields. For example, you could put the laws of the State of Minnesota into the system. You might have a machine in which you'd put all the statutes and all the cases relating to a given problem.

The field of libraries has been virtually untouched so far by this technology. What will begin to happen, partly in this decade and to a great extent in the next decade, will be the development of entirely different kinds of libraries which will be contained in information retrieval machines.

One of the big areas for application of this technology is going to be in medical statistics. Medical records are atrociously kept at the present time. A large element in the high percentage of wrong diagnoses in the medical field is the bad maintenance of medical statistics. We've done a lot of studies on this for the American Hospital Association. At the present time each hospital has its own system. In the small amount of data recorded, there's a very high percentage of misrecording and of loss of data within a hospital itself. There's the problem of a person being ill in one city, and trying to find out enough about him in time to treat him, while his record is in two or three other cities. It's virtually impossible to get the information rapidly, and in the time that's necessary for therapy. The result is that many people are badly handled, and people die, and are hurt in many ways simply because of the poor ability to handle medical statistics. You can link an information retrieval machine with medical statistics. If someone in this area is in Washington and is hit by a truck, you may want to know whether you can use penicillin or not. You can, in effect, and this is being done today, dial the system. It does the search and reports the information in Washington, rapidly printing out the medical history of the person.

You can link these information retrieval machines with communications networks so that you can communicate the data very rapidly. Telstar's a very good example of communication extending around the whole world. The telephone system itself is being used now for business, and computers communicate with one another. For information retrieval systems we'll use data networks of this kind. The American Telephone Company is investing and planning facilities for 1970 on the basis of there being a higher proportion of machine-use than of voice-use of the telephone system. In other words, they expect that the city-to-city communication on the telephone system by 1970 will be more heavily used by business machines than by voice. Recently I talked to the Director General of the Dutch Telephone System and he said this is exactly their own plan. They believe the telephone system of Holland as a whole will carry more traffic of this type by 1970 than voice traffic.

We're starting to do some of this overseas by cables. The communication satellites that are going up will be heavily used for this. One of our clients, one of the largest companies in this country, is already relying on it. They just bought a whole cable channel to connect their European with their U. S. comput.rs. There'll be much more intercontinental use of global information systems.

The information retrieval area is a very interesting one; you don't have to let your imagination go very far to realize that not just the general library, but all kinds of specialized libraries—law libraries, technical libraries, engineering libraries, and medical libraries—will use information retrieval systems. You can make a legal search in brief preparation with information retrieval machines systematically searching for all of

the pertinent cases, with the machine doing the case search. Today we have a surprisingly large proportion of legal decisions being handed down on the basis of inadequately prepared cases because the research hasn't been done properly. This is as fatal to some people as is the bad handling of medical statistics.

There are many things of this kind that are going on today that are handled badly. Or many things that are not done because the facilities aren't available. It has been estimated that about two billion dollars a year of the research and development funds in this country are duplication of research projects already going on. You could cut down on this by having machine searches of the literature made regularly and rapidly. Thus you have a much better chance of coordinating existing efforts.

Translation by Computer

These are some examples of the new machines coming out of the technology. Another example is in the field of translating. Today we translate Pravda each day by use of a general purpose computer. The editorial text is typed into the machine which translates this to English. We're starting now to build specialized translating machines which work from optical scanning. The machine reads the printed portion of the document, translates it from one language to another language, and either stores the translation or prints it out. We have the elements for this already, but we're going slightly beyond this in doing abstracts of translations. There are now a variety of computer programs which take a technical article and make an abstract of it. They are still very crude. All of these things go through a phase that sounds like science fiction. First somebody does it in a very crude way and everybody says it'll be 100 years before you can develop this. Then three years later it's for sale. The whole field has been going like this. In the prototype stage, everyone laughs, but a few years later it's being used commercially. But then everybody shrugs his shoulders and says, "Of course you do it this way; how else would you do it?" It's an extraordinary series of reactions. I keep a cartoon behind my desk—an original of one of the Charles Adams cartoons printed in the *New Yorker* a couple of years ago. Two caterpillers are talking to each other and they see a moth emerging from a cocoon above the caterpillers. For the first time this moth is spreading his huge lovely wings and one caterpillar says to the other caterpillar, "They'll never get me up in one of those things."

There are machines today that you can talk to and that will react to the spoken word. They can translate from the language in which the particular model is running into three other languages and speak out in the other languages as well as type a transcript of the translation. This is a five-word vocabulary language at the present time; but again, this much exists. As you get started, you gradually refine and develop it. The first

version of this will be a whole room full of equipment to translate a simple sentence. But you gradually reduce the room to much smaller pieces of equipment and you start handling longer sentences. Before a decade is out you start having a standard version of it, and maybe a few decades later you have the Dick Tracy wrist watch into which one speaks and which speaks out in another language.

You have many problems with these. The machine you talk to, like many of us, can't understand women or Texans. But later on it may do better than we do. There are terrible problems in the machine translation area; there are all kinds of syntax problems. We're actually learning a lot about language in the process, because all kinds of things come out of these machines which make us realize how complex language is. The classic story is of the machine that was translating from Russian to English and the typed version in English said, "We have much liquor but no meat," and it made no sense at all in the context so they brought in a Russian expert. His translation was: "The spirit is willing but the flesh is weak." I heard one the translators in Geneva told me last week. The story was of a machine that was doing English-Chinese and Chinese-English translation. They had just perfected it and displayed it. They brought in a philosopher and said, "Now what it does is that you type the English in here and it will print out the Chinese characters for it. So take any simple statement you want and put it in and it will translate and print out the Chinese." "All right," he said, "Let's put in 'Out of sight, out of mind'." So he typed it in and the machine churned it out in Chinese characters; and so they said, "See, it comes out in Chinese." So, he said, "Well I don't know really if that's what I said." "Well, that's very easy to test. We have an optical scanner here. Put the Chinese in and we'll run it backwards and you'll come out with the English." So they put in the Chinese for "Out of sight, out of mind," and the machine turned out, "Invisible idiot!"

We are starting to apply this technology to problems of information. When you think about it a little while, you realize there is an extraordinary array of problems that are concerned with information. There are not only problems of language translation and libraries, there are problems of traffic control, especially, air traffic. We're trying to prevent airplane collisions by using this technology. There's also the problem of ground vehicle traffic control. There are test automobiles running on test tracks today which have systems in them that prevent collision and systems that allow you to dial the parkway exit you want and the machine will get off at the exit you want. It's going to be a long time before we have these systems on a commercial basis. On the other hand, they're very likely to come because it's a problem we have to deal with.

We have horrible traffic problems in our cities. Some cities are starting to use computers. On Sunset Strip a computer now handles the

traffic lights for about ten blocks. It continuously measures the traffic and makes adjustments in the lights and the sequence, depending on the traffic flow. Baltimore and Denver have these systems in operation. At the present time they are confined to very limited sections of a city. Before long you will apply them to a wide segment of the city, and have them provide alternative routes for the traffic when you have a congestion in one area. These problems of traffic control, both on the ground and in the air are very serious problems and they're parts of our everyday life that are going to be very materially changed by this technology. We can go on, simply thinking about normal problems of living; you start to see a whole series of areas where the communication of information and the handling and processing of it could be changed, and changed for the better.

Technology is starting to change our society and it will change our society in many areas. When you think about automation you have to think about the roots—you can't think about today's products. Today's machines are obsolete. The machines themselves really are going to look like model T's or worse in a couple of years. The rate of change is very, very great. If you take a long range view of the social and human consequences, you have to try to look at the nature of the development, and then try to match this with human problems.

What could we apply automation to? Problems of application are great, as we found out in the business area. In retrospect it seems very simple to have put in eight or nine thousand computers in the last ten years or so. But the process involved many difficulties in actually putting them in, and trying to apply them to the simplest technological tasks. Trying to understand how to put a payroll on a computer involved many problems which don't seem great today; but they were very great at the time. Companies installing a computer for business use still have serious problems. At best, we're using them for pretty crude purposes. We're starting to use them for sophisticated purposes; but we're only just starting. We're beginning to see things we can do with them, but it takes years and years to change the systems and to apply the new ideas. That's going to be true of all these areas—such as the examples in translating machines I mentioned. There's a lot of work going on now of trying to understand language and trying to understand how you can build machines that really can smoothly translate and then abstract. It will happen, but it will take a long time, and there are great problems associated with it. All these things are not going to happen in six months or in a year.

On the other hand, it's very wrong to try to foresee the human consequences by looking at today and saying that there are going to be more computers and more numerical control systems. There are, but there are going to be all these other things too. The kind of world that people grow up in twenty years from now is going to be materially different from the present world. You have to look at the origins, the technology. It's an

ability to handle information—communicate it, use it, to whatever ends we want.

Technology is the Agent for Social Change

It's obvious that the consequences are great. Technology has always been important to us because it has been an agent for social change. The social change associated with this technology must be enormous. We use the term "industrial revolution," when we look back at the upheaval two centuries ago. Why did we use the term "revolution"? Partly because of the machines, but primarily because it created a whole new world. It accelerated social change and created a completely new environment for mankind. It took man off the field and put him in the factory life for the first time in history. It created mass production. Through mass production it created the first civilization in history in which luxury was not confined to a few. It created an entirely different tempo of life. It created a whole new human environment. It created all kinds of problems and a completely different life.

If this happened because machines were essentially replacing man's brawn, think of the kind of social change that will take place when you have machines that begin to do with information the things I've described. You will have enormous social change taking place, there will be the manpower change, with many fewer people needed to do the work. In addition to manpower changes, every job is going to change. You're going to change the whole nature, not only of how we do work, but what we do. You're going to change not only the procedures that we use — not simply how many people do what in the factory — but basically what it is we do. What do we choose to do? We're going to have a different kind of society resulting from this, and we know very little about it. We're only today beginning to grope with the realization that there's going to be a major change and most of the attention so far has been given to manpower change — how many more people in which job category. This is important, but it's trivial compared to the scale of social change that will be taking place and about which we understand very, very little. It's very important that we start to think about these problems because they're going to be enormous.

One reaction to this can be a feeling that we should slow down! It's very important to realize we don't have a choice; we have several important pressures that are going to make us go faster, not slow down. These all result from our not being an island; the rest of the world discovered this too. We're not alone. And it's not only the Soviets; our allies have discovered it as well. Europe is extremely interested in this field and is very active in it. My own European organization is growing at twice the rate of my American organization — very, very active in the field of automation. This is beginning to be true in Japan; it's going to begin to be true in other countries, in other parts of the world. They're all ex-

tremely interested in this field. They see it as the future. They have a great deal of imagination. And instead of a thirty or forty year lag, as we had before the war, in industry and technology, we may have a four or a five year lag at most; for they're moving very, very rapidly.

The Soviets consider this to be *the* great development—Khrushchev has made many statements to the effect that this is the means that is going to be used to lick our system. He stated explicitly that the Marxist-Lenin philosophy has always been strong on the use of new technologies as the means toward their social order. They espouse, and they are today beginning to publish, a large amount of theoretical literature dealing with this subject. And they say, "This is the means we are going to use to win." They call this cybernetics. They feel this field is the great innovation of the century and they are extremely active in it and extremely interested in it. The hero of one of the best-selling books in Russia at the present time is an automation engineer. It's permeating not only the technical literature that comes out in the Soviet but in the literature on economic theory and political theory. They've given it a very, very important place. They consider this to be one of the very important tools that they have for creating the kind of society that they want. They feel this is the great asset of mankind and they intend to use it, and to use it aggressively.

We are not operating alone. We have economic pressures. We're going to find international political pressures. We're going to find technological pressures themselves that are going to make us go much faster in this area than we've gone, whether we want to or not.

This being true, and the fact that there are material human problems associated with it, we should begin to give very high level attention to the problems of adjustment — to the social problems produced by this technology. The tendency is to feel that this will take care of itself, and that it's socialism to talk about any kind of concern over this sort of thing. Well, I'm a capitalist; I believe very strongly in capitalism. But capitalism is going to survive only if we seriously concern ourselves with social innovation as much as technological innovation. We're very much concerned with what one does when we have a high rate of technological change which is materially changing people's lives. In the first industrial revolution, the approach of capitalism was quite different. We said this will take care of itself. Well, one thing it produced was Karl Marx, and his ideas have had more to do with shaping our lives than any of us would have cared to be the case. We can't let that happen again. We don't have that kind of margin any more. We have to concern ourselves very strongly with the human and social problems associated with this development, and to realize the only way capitalism can be effective is to be dynamic and to change and evolve as the environment changes. It can't maintain itself by being static. At best, the bulk of the world is not going to be capitalistic. Our capitalistic system will be maintained only

if we give every attention to the human problems, the social problems, associated with the technology. We're starting to do this in a small way, but we must do it in a major way.

Discussion.

Question: Would you care to comment on the importance and implications in Manpower Development and Training Act?

Answer: I believe most of you are familiar with it. It's a piece of legislation that was passed a year ago and provided for research into the problems of adjustment to technological change; it provided funds for retraining of workers and it has established an Office of Automation and Manpower in the Labor Department to be concerned with these problems. I think it is one of the better pieces of legislation that has gone through in recent years. It's a very good first step to try to get into this problem. Seymour Wolfbein, who'll be speaking to you later in this series, is administrating it; and I think he has done a first class job of setting up the office and getting started on the problems. It's a huge problem. Very little has been done in this area and I think it's a good step. I don't think people should look at it yet, as anything more than a first step. I think we have a long way to go in that direction but it provides a start at trying to determine how to anticipate technological change. We've been waiting until the engine goes by, and then clean up the rubble. What do you do about anticipating it? To what extent can someone be retrained? At what points in a person's career does it change? What are the tolerances of retraining? How different a job can a person be retrained for? We don't know much of this yet. And these are some of the issues that are being explored under Manpower Act.

Question: You alluded to the consequences of this development and referred to the Industrial Revolution, that one of the effects was taking the people off the farm and putting them in the factory. Can you project where this is taking us?

Answer: In the last ten years or less, it has taken a lot more off the farm, hasn't it? And the rate of agricultural productivity increase has been about three-times greater than industrial productivity; so again you've had a big speed-up. You had a switchover from a predominantly agricultural society to one in which more people were engaged in manufacturing and non-agricultural tasks around the early part of this century. In 1955, for the first time in our history, more people were going into white collar jobs than into blue collar jobs. Before, we always had more blue collar workers than white collar workers; now it's the reverse. You're getting a shift now from manufacturing to service fields similar to what happened in agriculture. Manufacturing requires a decreasing percentage of the work force. As we have gone along, we find each of the things to which we have devoted most of our manpower has increas-

ingly become so productively efficient that we could cut down on the number of people involved in it. The service areas are clearly the big growing areas and these include the occupations of leisure, as well as the services associated with non-leisure.

Question: I was just kind of interested in parallel changes. Is the biggest change in the service area?

Answer: Much more in the service area — right. And many new services are growing up. There is much more in the education area, for example. One of the most dramatic changes that will occur is that education will not only be concentrated at the beginning of one's life. We have already more experience with continuing education, but not anything like the scale that we'll have. Some people feel all that anyone can learn is learned by the time one finishes school, as we know it. What people are going to have to learn is going to change a number of times. Alfred Whitehead has stated it very eloquently — the one person, who in the past was such a God-send of being one fixed person for one fixed task in life, is going to be a public liability in the future because the change is going to be so rapid. The only solution to this is to make education continuous through one's life — not just an occasional extra course as in extension, but rather a continuous part of our lives. This is going to be a much larger part of our lives, and it means many more people will be concerned with the education process.

Question: What implications does that have for vocational counselors?

Answer: I guess that's something that you can tell me more about than I can tell you. (See Samler's article. Ed.) I should think one thing you will need is a loose-leaf guidance book to keep track of the changes.

Question: In the recent past we have seen a great increase in the demand of more and more education to do the job that must be done. We've seen a great increase in the rank of unemployed people who are unskilled, have little experience, or no experience. We're finding a higher and higher percentage of people coming out of high school who cannot get further training or will not get further training who make up the bulk of the unemployed. Do you foresee this group to be increasing and that the answer might be a gigantic civilian conservation corps or another make-work program?

Answer: Let me answer the first half. Yes, I think this group's going to increase and continue. I think the President has made a big point of showing this to be one of the big problems and that the only way we can get ourselves out of it is by seeing that people stay in school. I don't think there's the slightest question about that. Certainly a domestic Peace Corps is one answer. The most obvious answer is to try to keep people in school and prevent dropouts. You need different ways of doing it. I would be much more inclined toward better ways of keeping people

in school, rather than feeling that a domestic Peace Corps is the answer to this problem. That doesn't mean a domestic Peace Corps isn't a good idea, but I should think that one could do more by trying to provide schooling. I'd prefer to see us do much more in the way of technical schools. We have a problem in engineering. We down-grade our engineering schools by trying to put vast number of people through them; the quality goes down. In Europe you can hire people who are trained technicians, who have gone through very good solid training as technicians, but who wouldn't have made first-class engineers. In this country these people go to very good engineering schools because we don't have as well-established a technical training program in terms of advanced schools for technicians, as distinguished from engineers. I would think that one thing that might keep some people in school longer if they didn't feel they had an either-or situation — either college or not college. This idea is not new, but we don't use it to any degree at all. Experimentation in these directions would help keep people in schools and keep us from having too many non-skilled people who have no job.

Question: What about the people with lower-level ability? I think some of us are concerned that you're doing away with the bottom of the pyramid. At one time you could represent our labor market in terms of a pyramid but now you represent it in terms of a diamond and it looks even as if we may have an inverted pyramid. O.K., then what do you do with these youngsters who have an I.Q. of 90 and below? Put them in a technological field?

Added comment from audience: As a substantial part of this, how many does this include — approximately 50%?

Answer: This is an area that is much more in your field than in mine. I keep feeling that people don't begin to use the capabilities they have and I wonder if people are really taxed to their limits. I don't know what kinds of positions a person with an I.Q. of 85 can or can't fill. It isn't my area — I don't know. But I don't think that we can create jobs only for Ph.D.'s in electronics fields. (Can't such a person be a good waitress, for example?) There are a lot of positions in society that I imagine wouldn't need very high I.Q's. and that I don't imagine are going to be replaced. When you talk just about the service field you come into areas where you have bad handling of these people today and you have many of them that require usual I.Q's. I'm not qualified for this.

Question: A good share of the Library School at Western Reserve, and the members of the Documentation Research Center there at the Library, among others, seem very much interested in automating library procedures. They seem much less optimistic than you are about the possibility of automating libraries either general libraries or technical libraries. One of the problems they point to is the fact that we haven't yet developed a conceptual system — a taxonomy for indexing. You have to tell

your computer what to do and it isn't just a matter of calling up titles any more. Titles aren't any good. You've got to really get to the heart of your document. I wonder whether you share this view?

Answer: That's right. That's unquestionably a very large part of the problem. I was trying to take a longer view of this. Sound judgments in 1946 were from M.I.T. that all the computing in the United States could be handled by twelve large-scale computers, invented the previous year. A year later they upped that to 50, and people thought that was outrageous. Well, we have 8,000 now!* People who are immersed in problems can sometimes get overwhelmed by the difficulties. I find this in my own firm. With two men working on two different sides of the same problem, one man says the blue sky people are talking about hospital data; the other man's working on the design of the system that admittedly will not come out until 1968, but that system is precisely what the first man is saying can never happen. Sometimes being immersed in a problem can cause this. What's the answer to the indexing thing? I don't know.

But there's a certain amount of work involving systems termed heuristics. At the present time about 100 people or so in this country are working on these systems. Heuristic systems are goal-oriented systems where you give the machine a goal and it works out its route to the goal. Today when you program a computer you give it very detailed instructions of what to do. You have, for example, some early chess-checker playing systems. At the present time you have a program for a general-purpose computer, and it plays checkers. In some of these programs, you give the machine all the instructions and you play against it. There are heuristic programs where you don't give any instructions. You simulate a heuristic system on the computer and the machine learns the game as it plays with you and learns the strategy that beats you. There are a couple of men who have been doing this for three years. They've been playing against the computer and the computer always wins. The initial thing is that in the heuristic system the machine learned the strategy and its own rules as a result of being told (having it's fingers locked) when it did something that wasn't acceptable. Some of the people in the heuristic field feel that the library indexing problem is going to be overcome by some such system which we call an associated memory system. This allows you to put concepts into the machine and the machine will search by the concept. We're still a long way from it. A team has just finished a report on the Library of Congress. The team reported in effect that immediately going into a system that puts the entire Library of Congress into a machine is not practical and that it would be an enormous expense. However, they feel that putting the catalogues into one of these machines is immediately feasible and it is not of a very advanced system. You're right — there are some terrible problems.

*End of 1964 more than 20,000.

Question: Your speaking about the computer that learns to solve problems leads me to ask whether you'd like to say anything about artificial intelligence because it gets very close to the field of human intelligence.

Answer: Ten years ago people used to ask, "Can machines think?" At that time you would have answered, "Of course not!" Now you have to discuss at length what you mean by thinking, what's intelligence. Each year Computer technology eats away a little bit at it. It gets harder to answer because if you ask, "Can the machine learn?" (anything that you normally mean by "learn.") you pretty well have to answer, "It can, today." You didn't answer that way a few years ago but now you can. You can work out a definition of learning which would fit what the machine does. If you honestly use "learning" in the normal way you use "learning," machines can learn. They can improve their performance based on the interaction with their environment. You have to have such systems if you're going to send a vehicle to a strange planet and you can't program it only with instructions. You've got to have something that can encounter a new environment and adapt to it. Thus you start to get work on these systems. Maybe there's more interest in this in Europe than there is here; we have gradually built up an interest in it here. What's happening is the same thing that's happening with a language. We're learning a lot more about problems of learning and problems of intelligence, and what intelligence is. The trouble is, you always have to attach a time-scale to anything you say in this field because we're in our absolute infancy. And the library problem is a tremendous problem. But, fifteen years from now, I'd be very surprised if you didn't have very heavy reliance on information systems in libraries that can do a lot. I don't know, maybe it's twenty years, maybe it's thirty years. But it's hard to believe that it's any longer than that.

Comment from audience: Can I tell you a story about this? There's a library in Britain apparently already automated. This was told at a recent information retrieval conference. The man who told about it said that he went in, was shown the system, was asked to dial a book. He got a busy signal and asked what that was. He was told the book was out.

Answer contd: One of the things we had at Geneva — the only exhibit that was at the Conference — was a Xerox system using University microfilms which they acquired last year. In this system the point was to show that a book is never out of print in that they have a microfilm. For the sake of argument, say, they have a microfilm of all the books printed in English from 1760 onwards. You ask for a book and it prints it out, and within the hour you have a bound copy of any book you want in the United Nations Library. They brought over a microfilm for a number of technical areas. The point was that it was a beautiful display because it made the point even though nothing's out yet. Xerox is now selling to new Universities and to new community colleges a book service for a

basic list of, I think, 60,000 volumes (I really don't remember the exact number). It's a list of titles that was put together by one library association of a basic library. Well Xerox goes to the library of the new college that's starting and says, "Half of these are out of print." The library can buy the part that's in print. But Xerox says "We'll sell you a service for the part that's out of print. You simply have a catalog and when the person asks for a given book, there'd be one day delay; but we'd print the book for you. In this way you don't need to invest the additional ½-million dollars in these books. They're all available to you as they're used.

Many of these things come out of the military. When you look at the military intelligence system and the military information system you have, to a certain extent, an idea of what the business system will look like ten years later. You have military systems which display on whole wall panels, or large screens, changing situations in the world. A map, for example, with an intelligence estimate of where troops are and what is happening. It's continuously being updated, like a television picture with a live display. You have systems where, if you want, you can press a button and out comes a hard copy. It's printed for you in color.

You can have electronic displays, though in most systems you can't get out documents. It's hard to believe. We're in the middle of the design of a newspaper system. It dummies the newspaper by having a large TV for the editor; he calls up the stories he wants, and the TV screen shows them in type the way his page will look — but it doesn't exist except as an electronic trace until he gets it as he wants it. He makes exchanges and does his editing with a light gun; he calls up more copy on the story; he changes the structure, enlarging or decreasing the size of the picture. Once the page is the way he wants it, he presses a button and it goes into type and it exists. Up to that moment it had existed only as a trace on the screen. This system will be running by 1966. Some of these things go faster than others.

Question: In this vein, the newspaper strike in New York seemed based, in large part, on a reluctance to accept automated procedures. Would you have any comments or thoughts on how you can overcome this resistance to change on the part of the people being automated?

Answer: It's not easy. We're right in the middle of that on this newspaper problem. It's highly compounded. It's not only the basic problem of overcoming a person's concern about losing his job — which may be very real. It's also compounded by the fact that you have a lot of unions. For example, the International Typographers were striking in New York. There may be a lot of specific circumstances surrounding that strike which may set it apart. But basically the typographers union probably won't exist, as that function won't exist in any of these systems in the future. You'll print by off-set rather than letter press. The lithographers

union is one that is benefiting by this. So one of your problems is overcoming not simply man's resistance but the problem of a union fighting for its existence. The lithographers last year offered a million dollars to the industry to do more automation research because they're expanding and they feel they'll gain. What can be more debasing to a human than the make-work system of the newspapers. A department store sends in a plate of its ad. The plate then is put on a press and run, but the man has to sit and set the ad in type, strike a proof, compare it with the department plate, make the changes, strike another proof that's correct and then destroy the plate he's set up. And he sits there all day doing this. They get behind as they get these backlogs of this work. Randy Hearst told me last year when he closed his Detroit paper (they closed the whole paper) that the union came to him and said, "You're 51,000 linear inches behind in setting type that has to be destroyed. Open up and just hire people to set the type and destroy it." What can be more debasing to a man spending his whole life doing his work and then destroying it?

You've got a whole variety of problems of this kind. What do you do to solve them? We don't know. We've had a half-dozen experiments on setting up programs that will provide funds for people shifting over, and provide for retraining of the people. There are efforts made to be sure that the individual will never have a decrease in his pay, even though he goes to a job which will normally have a lower rate. There are a whole variety of schemes of this kind — some work well and some work less well. In San Francisco, in effect, the industry is paying the union 12-million dollars a year for an open-end arrangement to do anything they want. The result has been more jobs created than there have been before. They went in with heavy technological change that allowed them to reduce their cost, and they got a lot more traffic through than they would otherwise have had. Harry Bridges has had an increase in the number of jobs for his people, and they also have 5-million dollars a year to use for cushioning people who have been in specific situations. A book has just been published by the Harvard Business School on automation funds. We're in a stage of experiment; I don't think we know.

Question: As far as national goals of countries are concerned, do you think that the numbers of people going into technical science as compared to social sciences will have an implication in the future? In other words, do you feel enough people are going into social science to solve some of the implications of the machines?

Answer: I don't know what the figures are, but I do know the people in the social sciences aren't devoting their attention to it. Almost all of them are writing books about the social consequences without ever looking at the phenomena. And they have Charlie Chaplin in mind, you know. It may be worse, it may be better; but the psychological situation

of the man is totally different and the job condition is totally different. We're paying people what's called lonesome pay in the process plants-bonus pay because the man is lonely; there is no one to talk to. There are lonesome pay clauses, and the psychological situation is entirely different than it was, but the sociologists go on writing their books without getting in to look at it. I don't think the people who are in the social sciences are doing a really first-class job on the problem.

Labor's View of Automation

CARL WINN

Recently, a cartoon appeared in one of the local newspapers which showed a school teacher sitting before her kindergarten class, apparently engaged in a discussion of what the children wanted to be when they grew up. One of the children is observed to say — and this is the caption under the cartoon — "I'm not making any plans for the future, Miss Feeney! . . . any career I pick will probably be automated before I grow up, anyhow!"

I am not saying how much the problems of automation have penetrated the kindergarten level, nor am I saying that the child who spoke had an imperfect understanding of the problem, either. What I am going to try to do is to discuss with you some of the changes that automation has wrought on the work force and the economy, both locally and nationally, with particular emphasis on the effect that these changes have had upon the worker.

Some argue that automation is merely an extension of the historical process of technological change; others say it is something radically different from what has gone on before. In my opinion this is not the most important argument concerning automation. More important than whether it is something old or something new is the fact that automation is having serious and far-reaching consequences for the work force and on the economy of our country.

The three most important characteristics of this new form of technology are: First: the direct control function in the process of production is taken out of the hands of the workers. Automation involves the use of hydraulic and electronic devices to control other machines. An important aspect is feed-back control or automatic self-correction. One example with which we are all familiar is the thermostat. It automatically increases or reduces the fuel supply when the temperature of the room goes above or below a pre-set level. I might add that the normal house thermostat has been refined through the use of dual thermostats, one indoor and the other outdoor. As the outside temperature changes, the dual thermostat anticipates the need for fuel subject to correction by actual room temperature level.

The second important aspect of automation is the use of large electric computers which can, with great speed, record, remember and manipulate data which has been fed into it. For example, in 1959, the Texas Company added an electronic computer to provide central, automatic controls for its Port Arthur, Texas refinery, which first started operations in 1942. A human operator simply could not look at about

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50 recorder-controls, then relate the readings that show the level of activity of the reaction and other relationships, in time to reset the controls to keep the plant operating at maximum efficiency. But Texaco's computer has no difficulty doing that job every 5 minutes — 24 hours a day.

The third aspect of automation involves the use of continuous automatic production, sometimes called "Detroit Automation" and involving units in a single continuous production process. One of the best known examples is the machining department of the Ford engine plant in Cleveland. In 1952, Ford started operations in this plant to machine automobile engine blocks with a battery of 71 machines linked together into an automatic assembly line 1600 feet long. Machine tools perform more than 500 boring, broaching, drilling, honing, milling and tapping operations, with little human assistance. Each operation is synchronized so that the line moves forward uniformly. The production of this plant shortly after it started operations was 154 engine blocks an hour and required only 41 workers compared with 117 men required to turn out the same production using older methods.

It is said that when Walter Reuther, President of the United Auto Workers, was shown through this Ford Plant in Cleveland, a company official proudly pointed to the new automatically controlled machine and asked Reuther: "How are you going to collect union dues from them?" Reuther answered: "How are you going to get them to buy Fords?" This alleged conversation indicates that no one may have the last laugh as the result of automation.

The impact of these various forms of automation have differed in different industries. Feed-back automation is most prevalent in the chemical and petroleum industries. Computers have been widely used by banks, railroads, insurance companies, governmental agencies, and office operations of large companies.

Detroit Automation has made its biggest impact in the metal processing and metal fabrication industries. The distinctions between different types of automation are important to keep in mind because the consequences for the work force may vary widely for each type. Let us look at some of the consequences of these changes.

First of all — automation has been associated with a reduction in total employment because the same or greater output can be produced with fewer employees than in the past. This is the situation in the meat packing industry and the brewing industry, for example. A similar contraction of employment has taken place in banks and insurance companies — but in these latter situations, employers have stated that there has been no unemployment in spite of the fact that employment levels were reduced. This seeming contradition is explained by the claim that no employees were displaced by automation; instead reductions were

made in the work force thru attrition — as employees quit, retired, died or were discharged, they were not replaced. If a business has a high turnover rate, the pains of automation can be eased. In this way — according to theory "no one gets hurt" as the result of automation, but the fact is that there is a decline in the total number of jobs available in the economy as the result of automation, unless the total economy grows fast enough to provide new jobs to take the place of those displaced by automation and other causes.

The situation is complicated because the introduction of automation itself creates some new employment opportunities for those who otherwise would be displaced by the introduction of automated methods. In other cases, such as the chemical and petroleum industry, automation has created little immediate unemployment because of the output of these industries has increased greatly during the period when the changes were introduced. This means, to look at it in a slightly different way, that while employment has been maintained intact, employment opportunities have not expanded proportionately with production. The labor force in the chemical industry (I'm referring now to production and maintenance employees) has remained pretty constant since 1953, at about 850,000 people, but output has increased during the same period by 80 per cent. In this way, the harmful consequences of automation upon employment has been muffled or deferred. What would happen to total employment in the chemical and other automated industries if demand were to drop. This may be one of the delayed reactions to automation which vocational guidance counsellors should watch.

This distinction between total employment and loss of employment opportunities is important because when a recession occurs and production is cut back, many workers are laid off and some of them have only a slight chance of being recalled once business conditions improve. Management may feel an obligation to soften the effects of automation when it is introduced, but when they live with it for awhile and a change in the business cycle occurs resulting in layoffs, there is a tendency to retrench and automation results in a failure to recall workers. This has happened in the automobile industry, the steel industry and in the textile industry. Following each of the four successive post World War II business recessions, the work force necessary to bring industry output back to prerecession levels was significantly lower in these industries than in the period before the recession. The fact that unemployment does not immediately result from automation has sometimes lulled workers and management into a false sense of security, so that little attention is given to the various programs which might soften the blow.

Automation has also been associated with a geographical shift of production facilities. Rather than install new equipment in old buildings or in downtown office areas, employers often use the occasion to shift plants to other locations. The reasons may vary: sometimes it is a desire

to be closer to raw materials and markets; sometimes a desire to get out of a congested area into the suburbs; sometimes it is to seek out some of the supposed advantages of operating in a so-called "right-to-work" state.

When there has been a geographical dispersion, theoretically, jobs still exist in the sense that total employment on a nation-wide basis remains the same; but the jobs are now distributed over distant labor markets. This is little comfort to families in Northeastern Minnesota, for instance, where the worker has built his home and his social and economic life around the now abandoned plant and is left with a dwindling severance paycheck and unemployment compensation.

We have all heard that automation has had the effect of "upgrading the work force" and we have all been impressed with this because it seems to be a great benefit to society to up-grade the workforce. This does not mean that specific jobs associated with technological change require greater skill or involve greater difficulty in carrying out necessary functions. What has happened in many cases is that the work force has been up-graded largely through the abolition of jobs of lesser skill. The Bell Telephone System has replaced a large number of long distance operators and office workers with a relatively small number of technicians and repairmen through a long distance direct-dialing system. This is made possible by automatic message accounting to record both local and long distance calls, to assign these calls to the proper account and to automatically prepare and print telephone bills.

In many factories and refineries, automation has cut deeply into the unskilled and semi-skilled jobs; just the kind of jobs, incidentally that many of our high school graduates with no further schooling have gone into in the past in such great numbers. In the office, the use of computers has taken away jobs from file clerks and recording clerks of various descriptions. Thus, a larger proportion of the job opportunities available under the new technology fall into the relatively skilled categories. That is how the labor force, by and large, has been up-graded by automation.

A significant fact for vocational counselors in all of this is the increased importance of the so-called "non-production" worker in the occupational composition of the labor force. Let us take the chemical industry again, for example. You will recall that total employment in that industry has remained relatively constant for the past ten years, despite vastly increased output. However, while there were 3 production workers for every non-production worker in 1946, there are now only approximately 1.6 production workers for each non-production employee. In other words the ratio that was once 3 to 1 is now moving closer and closer to a one to one ratio.

At this point, let me summarize the observed effects of automation on employment:

(1) Automation has resulted in net decreases in employment or employment opportunities in specific cases.

(2) Automation has resulted in greater geographical dispersion of employment opportunities.

(3) Automation has had the greatest negative impact on workers in the unskilled and semi-skilled categories.

Thus, when we talk about the effect of automation on employment we are not just talking about whether or not total employment will grow or decrease as a result of technological change, we are also concerned with what labor economists have called the structure or composition of employment. This gives rise to the term "structural unemployment" which we have been hearing about so much recently and which we will continue to hear a lot about in the future as the consequences of automation are increasingly felt.

There are other problems concerning automation and the worker which should be mentioned. In addition to altering the occupational composition of the automated plant or office, the new technology has also changed the content of specific jobs. This development has had two aspects: First, job consolidation and, second, new job classifications.

Where two or more separate job classifications existed before, they are frequently replaced by a single comprehensive job classification. In automated power plants, for example, three operator classifications have been combined into one. In the automobile industry, management has sought, over union opposition, to combine several distinct crafts into a single job classification designated "automation maintenance man". In the petroleum industry, job consolidation has come to the point that in some companies the entire job structure is made up of only two job classifications. The worker enters at one job level, then progresses to the other classification, and that's it. Such consolidation has brought the traditional craft skills under fire and has created further problems of training and determining qualifications for job holders. These developments contain implications for the nature of traditional apprenticeship training programs and other devices used to up-grade individual members of the work force.

Automation has spawned many new jobs for which there is no clear precedent or comparable classification under the previous technology. "Instrument men" and "master console operators" have appeared in bakeries. Office staffs now include "programmers", "tape librarians", and data processors". These classifications have an impressive ring to them, but it is not at all clear that the total skill content of the new jobs created by automated methods have been up-graded. In fact, one careful study

of new jobs in manufacturing concludes that the skill content has been reduced, that the operating functions have been changed to watching rather than controlling or directly regulating the operations of the machine. Similarly, the console operator in a bakery requires far less skill than the master baker, now that the task of preparing and mixing ingredients has been taken over by automatically controlled devices.

The problems I have mentioned bring up another problem created by automation: What is the proper basis for compensating for these new jobs? Under existing job evaluation systems, which are in effect in many manufacturing plants and offices, wages are related to total points assigned for a range of factors including skill, responsibility, education, et cetera.

After automating, it is necessary to reassess the appropriateness of these job factors and the weights assigned to each one. Up to this point, management and unions have not been able to see eye to eye in these situations. Management will often contend that wage rates for the new jobs should remain the same as the jobs they replace or even be reduced because of the less exacting skill requirements on many new jobs. On the other hand, unions insist that increased worker responsibility and productivity should be the basis for an increase in wages.

In some situations, the employer has taken the path of least resistance and, with the consent of the union, has added a nickel an hour, or some other modest sum, to the rate paid for the old job. This may solve the immediate problem of pricing the job, but it avoids the long run problem of building a reasonable, fair wage structure based on the new conditions of employment.

The wage problem is compounded further by the fact that many of the existing incentive systems are not appropriate to the new technology. As you know, most incentive systems are founded on the notion that the worker controls the speed of production. But, one of the characteristics of automation is that it removes control over the process of production from the hands of the worker. Most unions use strikes only as a last resort, they tend to cooperate with management by negotiating arbitrary changes in existing incentive plans, even though the changes cannot be justified by the logic of the plan itself. In the rubber industry, for instance, the basic time value in that industry's incentive plan was arbitrarily increased by 50 per cent and this is the way they solved the problem. Although such expedients may be justified by circumstances, they are not substitutes for more profound attempts to develop a more appropriate and equitable system of compensation.

Another set of issues requires attention at this point. On the one hand, automation appears to have resulted in a significant improvement in physical working conditions and employee safety. The new production processes are often cleaner and quieter than the ones they replace. Also,

by physically disengaging the worker from the production process, the usual variety of factory accidents seems to have been reduced. However, instead of lost limbs and bad backs, there is some indication that automation may take its toll in ulcers, tensions which arise from long hours of watching, and other psychological disturbances. In this respect, one union in Great Britain demanded that employees in an automated plant be given an increase in pay to compensate them for the fact that they could no longer get the "psychic gains" of talking to their fellow workers while on the job.

Related to these psychological factors is the increase in shift work in automated operations. Because of continuous process operations and the high cost of the new equipment, work schedules have often been extended to a 24-hour, seven day basis in many plants. It is important to note that shift work is being increasingly applied to office work. White-collar workers are now subject to the same disruptions of family life which have characterized their blue-collar brothers for many years. In addition, the use of computers and automatic data processing systems have subjected white-collar workers to discipline and restraints heretofore associated with factory employment exclusively. While an office worker in the past could stop work to talk with a neighbor or go to the ladies' room without notifying anybody, her absence may, today, interrupt an integrated work system based on the close interdependence of all operations. It may be that white-collar workers will have to pay greater attention in the future to questions like shift differentials, relief periods, and work schedules; matters which they didn't have to bother about in the past.

Having discussed some of the problems created by the introduction and spread of automation, let me mention some suggested solutions.

First: there is the question whether primary reliance should be placed on governmental activities or on private collective bargaining between unions and management. In some instances, collective bargaining is to be preferred because it can do a better job of solving the problems which arise in specific shops, under specific circumstances, involving specific workers, than any government official. But, there are some things collective bargaining cannot do. It cannot stop automation.

Years ago, Samuel Gompers, in addressing the A.F. of L. convention said: "Accept the machine, organize the worker." Then, he promptly disregarded his own advice with respect to his own Cigarmaker's Union when he refused to accept automatic bunch-breaking machines in cigar production. By 1924, when Gompers died, that union was severely weakened because most of the manufacturers had shifted to machine operations. It is clear in the area of automation that unions alone — or even with government help — cannot stop the process of technological change.

Nor can collective bargaining create jobs. We have an example of this in the railroad industry. Railroad employment since the end of World War II has gone down approximately 750,000 jobs, or half the total number of jobs which were available in 1946. Railroad employment is now at the level at which it was in 1892. But a simple little thing like a contract, requiring advance notice of technological change can be of great help.

There is a question whether collective bargaining can do the whole job of easing the effects of automation on the worker; is this not also a matter for government to work on because it is also a general social problem?

Some stubborn facts that have been recently revealed cry out for remedial legislative action. In the next 10 years, about 20-million new, young workers will enter the job market. Therefore, to those displaced by technological change must be added those new workers entering the job market, if we are to estimate the total number of new jobs that must be created. It amounts to about 3½ to 4-million new jobs a year for the next 10 years. This is not based on any theoretical projection of population growth; these people are already born and are in school. So, we have a highly accurate forecast of the number who will be in need of jobs and the number is alarmingly high when compared with the forecast of available jobs, based upon normal mortality rates, retirements, et cetera.

If current trends continue — 5½ million of these 20-million new workers will not complete high school and hence will be ill-fitted for jobs in the coming years of rapid technological change.

Thus, we have illustrated for us very sharply, the necessity for a more rapid rate of economic growth. The average 2½ to 3 per cent of recent years is not enough to head off growing unemployment in the years to come. Only through a policy — aggressively pursued — of full employment, can we cope with the triple problems of present high unemployment amounting to over 5½ per cent of the work force; unemployment due to technological change; and unemployment due to new entrants into the work force who are coming in faster than our capacity to provide jobs for them. If we cannot solve the problem through more rapid economic growth, we will have to seek solutions such as a cut in the work-week.

There is cause for alarm in the tendency to be content with a too-high acceptable minimum level of unemployment. Hardly anyone in this country will admit publicly that even 3 per cent unemployment is attainable today, although this figure was widely accepted only about 7 years ago as the highest acceptable level of unemployment. Now it has become popular to advocate 4 per cent unemployment as the national goal, although this is at least 1 million more unemployed people than

the history of this country indicates is a reasonable and attainable figure. Meanwhile, the official figures are challenged by many for understating the level of actual unemployment by, among other things, disregarding the under-employed and those on short work weeks.

There is no problem that automation can create in the United States that full employment cannot solve. But the record of unemployment shows that with the exception of one month, every month in the past 5 years has seen an average unemployment rate of over 5 per cent and it is currently running close to 6 per cent in the nation as a whole. Some distressed areas have unemployment rates of 10, 12, 20 and 25 per cent of the labor force.

Unemployment traceable to automation has increased over the years. Technological changes between the end of World War II and 1953 brought only a few dislocations concentrated largely in textiles, railroading and coal mining. During that period, rapidly rising sales and increasing job opportunities cushioned much of the disrupting effect of changing technology.

Between 1953 and 1963, however, sales and output increased at a slower rate than previously. In 1955, automation began to spread rapidly. As a result, the economic and social impact of automation was sharper than in early postwar years and it spread to numerous industries, including automobile manufacturing, the steel industry and parts of electrical manufacturing. It was particularly marked as the economy moved out of the third post-war depression in 1958, after many companies had taken advantage of the recession to put in new equipment to increase output at lower unit cost.

No one can be certain about the speed of applying automation in the next few years. Some industrial processes, such as continuous-flow operations, lend themselves to easy conversion to automation. With others, automation can be introduced only after changes in the production process and, perhaps, in the design of the product itself. Most kinds of work, however, can be converted to some degree to automatic or semi-automatic operations. The extent of automation's future will depend largely on the speed of its introduction — currently, the speed is increasing . . . and the rate of economic growth currently is stagnating.

Viewed objectively, the new technology represents new tools for the production of economic abundance for all. It raises productivity, reduces direct production costs and promises to provide the basis for a great improvement in living conditions and an increase in leisure time. Assurances about the long-run benefits of automation do not help solve present problems nor provide answers for those that may arise in the future. Automation results in increased productivity. But, increased man-hour output without an increase in total production and growing markets will lead to depression. If automation spreads rapidly and sales

rise at a slow pace, joblessness will increase. Without customers for the mounting output, unemployment is inevitable. Contrary to popular belief, job opportunities have not been expanding greatly in industries that produce automation equipment — except for professional, technical and other white-collar jobs. These industries, too, have been automating.

Increases in the buying power of wage and salary earners are required to build expanding consumer markets and to set the stage for full employment. New government policies are needed to encourage economic growth and to cushion the disrupting effect of rapid technological change on working people, business and entire communities.

Economic and social policies to cushion the effects of rapid technological change will not occur automatically. Positive measures must be taken by the government and private groups to sustain economic growth and minimize the burden on the worker so that the ultimate creation of economic abundance can become a reality.

Let us look at the economic cost of 1 per cent of preventable unemployment. One per cent sounds like a small number, but since there are about 72 million people in the labor force, 1 per cent amounts to 720,000 people. What are the lost wages of 1 per cent unemployed? Multiply 720,000 by 2,080 hours, the number of hours a person works if he is employed 40-hours a week for a 52 week year. The result is 1½ billion man-hours that were not worked. At a rate of $2.00 an hour, this amount to 3 billion dollars in wages alone that were not paid. But this is not all. Think of the steel that was not produced, the washing machines that were not bought because they were not manufactured, and so on. Think of the taxes that were not paid and, consequently, the schools and other public buildings that were not built. Think of the unemployment compensation payments and the welfare payments that had to be paid out to these 720,000 people and their families. Some economists figure that the loss in gross national product of 1 per cent unemployment is about 15 billion dollars a year — and remember, we have been talking now only of 1 per cent unemployment when the latest figures from the U. S. Department of Labor show that unemployment is 5.3 per cent for the country as a whole. It is very clear that we cannot afford this high rate of unemployment whether we view the problem on human terms or in terms of our position as a world power.

What can be done about the problems of automation? First and foremost, the solution lies in a full employment economy, as I have tried to point out. Next, it seems to me that collective bargaining can lead the way to facilitate the orderly introduction of automation over a period of time, thus reducing or minimizing the resultant dislocations.

Third: collective bargaining can provide standards and procedures for the fair distribution of existing employment opportunities in such things as inter-plant transfer systems which provide that people shall

move with the jobs; retraining, pursuant to a collective bargaining contract; and enlargement of seniority units. In many instances, unions have enlarged seniority units to include not only departments, but companies, and the union is working toward company and industry-wide seniority units in the automobile industry. Collective bargaining can help expand economic opportunities for those most likely to be hit by continuing automation. Studies of unemployment show that the people who are hardest hit are members of minority groups, people over 45, unskilled workers, and young people attempting to make their way into the job market. Unions are attempting to break down barriers of discrimination in hiring.

Collective bargaining can develop standards for sharing the costs of technological change. Technological change is bound to affect some people adversely and to help others. What happens in many instances is that the cost of change falls unfairly and too greatly on the shoulders of the worker.

Collective bargaining can develop standards for an equitable sharing of the fruits of this change, since it is clear that automation is associated with great increases in productivity. We have advanced somewhat toward this goal in such ways as the acceptance of the annual improvement factor relating wage increases to increases in productivity.

Having mentioned some of the things that the labor movement through collective bargaining can do, I must hasten to add that I don't think that this will take care of the problem. The latest figures from the AFL-CIO show that it has in the neighborhood of 14-million members. The labor force is composed of about 72-million workers and is growing at an annual rate of close to one million at the present time.

But society, and that means all of us, must also live up to its responsibility to provide for a stable social and economic structure. This is a problem for all of us. Let us look at how we have met our responsibility.

In 1961, the 87th Congress passed Depressed Area Legislation. Twice Congress had passed area redevelopment bills, but each time President Eisenhower killed the legislation with a veto. Senator Douglas of Illinois introduced his proposal early in 1961 for three 100-million dollar revolving loan funds for industrial and rural redevelopment loans and also providing for the construction of public facilities. The bill also authorized vocational training for unemployed workers and subsistence payments in lieu of unemployment compensation for workers receiving retraining benefits. This bill was passed in the spring of 1961. It was the merest beginning in the attack on depressed areas and unemployment. It provided for the retraining of only a few thousand workers for periods up to 16 weeks. Can a worker be up-graded in skills sufficient to get him a decent paying job in this short space of time? The question

that many workers ask themselves after entering such a program is: "Retraining for what?" And that is what we must ask ourselves. If we cannot do the job of handling job retraining and depressed area problems properly, we may be wasting our time and our tax money. Unfortunately, a lot of money seems to have been wasted in the area Redevelopment Act retraining program.

The most important gain from the retraining provisions of the Area Redevelopment Act may have been the experience gained as a result of attempting to work out this problem, because in 1962, a large-scale program, called the Manpower Development and Training Act was enacted into law. This is a 3-year, 435 million dollar program to retrain unemployed workers in new skills and set up an on-the-job training program for new workers. It provides for vocational retraining for unemployed workers with subsistence allowances and in some cases, travel allowances. It will affect approximately 1-million workers in the 3-year period in which the Act is designed to operate.

Our record on unemployment compensation is spotty. Most states, including Minnesota, have not kept unemployment compensation payments up to the level of 50 to 60 per cent of weekly earnings as was envisioned when unemployment compensation was first inaugurated as part of the Social Security Act of 1935. Minnesota enabling legislation provides for payments of up to 38 dollars a week for 26 weeks. This may have been sufficient when average weekly earnings—and the cost of living — was 50 per cent lower than it is now, but it is not sufficient today. The type of unemployment we have today means that a worker is out of a job for longer periods of time before he can find a new one.

Jobless workers by the thousands are using up benefits available under a crazy-quilt of state unemployment insurance programs. Taking the nation as a whole, these programs are inadequate, unfair and discriminatory. Federal standards establishing minimum amounts and duration of benefits are urgently needed.

There are other matters I could mention in connection with our successes and failures to cope with this tremendous problem which is being increasingly accentuated by the spread of automation. Within the past few weeks, the Canadian government has started to take some revolutionary steps to cope with their problems of automation. Legislation has been introduced in the Canadian House of Commons to relocate workers who have lost their jobs because of industrial changes. This bill calls for the Canadian government to pay half the cost that any province or industry runs into in moving jobless workers and their families to any other part of Canada where a job is available. In addition, the legislation will provide for research well in advance of major technological changes, and will provide for technical and financial aid for

labor and management to make plans to handle oncoming changes. The government will pay what is called a "labor mobility incentive" to a worker dislocated by industrial change who can't get another job in the same area or can't move elsewhere without help.

The purpose of the bill is to insure that the "human consequences" of automation are "minimized".

The U. S. Department of Labor has divided the country into 150 major labor market areas and hundreds of smaller ones. Of these 150 areas none have labor shortages. Seven have relatively low unemployment; the rest—143—have unemployment ranging from 3 per cent to over 12 per cent and are classified as having moderate and relatively substantial unemployment. And this does not take into account hundreds of smaller areas of substantial unemployment. So—in addition to asking the question "Retraining for what?" we must also ask ourselves "Relocation for where?" because up to now we have not been getting our economy moving sufficiently fast to meet the responsibilities of society in aiding those workers who, through no fault of their own, are the victims of cyclical unemployment. Today—a major portion of unemployment has been, and is being caused by technological changes applied with insufficient foresight and concern with the human consequences.

In conclusion, let me emphasize again that pump-priming, aid to distressed areas, retraining programs, even relocation allowances, are not enough. The problems of automation cannot be separated from others which cause unemployment. If we do not have a "full employment" economy in which everyone who wants to work has an opportunity to work, we are not going to solve the problems created by automation.

Social Effects of Automation

EDWARD GROSS

A recent subject of interest in the analysis of work has been that of alienation. One study showed that of all manual workers, printers were the most likely to report that their jobs gave them a chance to try out their own ideas. The semi-skilled in leather, saw mills, automobiles and iron and steel were least likely to report this.[1]

As I looked at this literature, I began to wonder whether guidance counselors could not also be conceived of as alienated from their work in one sense. Part of their task, as I understand it, is to counsel persons in their attempts to find a satisfying place in the world of work. Yet that world is changing so rapidly that it becomes difficult to keep up with it. There is another approach: what about trying to change that world itself? What about trying to alter the socio-technical system into which persons are counseled? This is a rather large order and goes contrary to the usual definition of the counselor's role, but it is a theme which will underlie a number of the remarks I want to make today and it is one to which I shall return at the close of my remarks. Meanwhile, I use it as a justification for taking two roads in my remarks — a high road and a low road. The "high road" will consist of a discussion of certain changes in the values of society and the values of the worker that I believe automation is occasioning; the "low road" will lead to consideration of the internal effects of automation—that is within the firm—effects on the individual and on work groups.

No one writes utopias on the grand scale any more. If we seek a picture of the future golden age, we find the only persons who will tell us what is will be like are the science fiction writers. Not only do they paint a different picture from the pictures the utopians paint but they pay attention to wholly different things. The utopians were primarily concerned with man—either with saving him from a perverting society or with perfecting him. It is interesting, too, that utopians usually saw the physical setting as simple. The science fiction writers reverse the emphasis: It is the setting that occupies their imagination and man is seen primarily as a creature who thinks up new and better machines. In this process, man himself is viewed as mainly a thinking machine and, in the interests of full employment, as a consuming machine whose appetite is insatiable. Such a man is no man at all for he has no values and without values he cannot make choices. It is this fact that I want to direct attention to particularly. Realistic forecasters of the future, when they seek to do more than entertain, do recognize that man has

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values, but their forecasts are limited by the assumption that the man of the future will have the same values as the man of today.

I am not talking about the emergence of a Martianesque creature with a structure and personality beyond our comprehension. I am assuming that human nature will remain much the same as it is now. Man will go on loving and hating, taking pride, shaming others and being ashamed, honoring and insulting, pitying, being vain, being shy, feeling guilty and all the other things humans do. But his social and cultural values—his standards and the things he feels worth striving for will, as they have in the past, change. The forecasters, especially of economic and employment trends seem, to me, to assume little such change; and for good reason. Such changes, often called "institutional" or "structural," require for analysis moving outside the scientific specialty of many of the forecasters.

I would like to look at some of these institutional or structural changes. The Great Recession (to give a name to the economic events of 1960 and 1961) properly focused attention on the volume of unemployment, but in spite of the many and reliable data given us by the Bureau of Labor Statistics and the Census Bureau, we are not given clear guidance on the interpretation of the data. The generation that went thru the Great Depression will become disturbed at *any* unemployment but now we are told that a certain percent is to be expected or is "normal," a word which must bring small consolation to those to whom it refers. The model such analysts seem to be using is that of a machine with certain inherent frictional costs or an organism with certain maintenance mechanisms which absorb a certain irreducible minimum of energy. But to speak of normality in that way is like saying a certain death rate for a country is normal. It is normal only given the existing state of medicine and sanitation.

For one thing, percentage of unemployed may vary from country to country because of different assumptions as to who should be working. In France, for instance, all farmers' wives are included in counts of the labor force, but they are automatically excluded, whether they work or not, in Sweden. In the U.S. we classify a person (with certain exceptions) as unemployed only if he is seeking work. Clearly the number of unemployed might go up precipitously if any large number of housewives should begin looking for work. Even if such statistical matters were cleared up, and we all operated from the same assumptions, a certain percentage of unemployed is normal only if we assume we must have our present standard of living. We could absorb several million of the presently unemployed by agreeing to share our work week with them; in other words by underemploying them—a practice much in evidence in the Middle East, the Far East, and many parts of the world. From this point of view, the normal unemployed make it

possible, however involuntarily on their part, for the employed to enjoy their high income.

Another argument in defense of the normality theory asks us to see the unemployed as a sort of lubricant for the social system. The unemployed provide the slack making it possible for manufacturers to tool up, for firms to close down a plant in Minnesota and open one up in Venezuela, or to decentralize if policy warrants it. Through such means, American industry retains a flexibility which makes it possible for it to adjust quickly to external pressures and competition. Such a claim, assuming it is the only way of securing the obviously necessary flexibility, makes the worker and his community bear the full weight of costs.

That this is not the only possible arrangement may be discovered by looking at Japan. Japan came late into the industrial world and in her rush to catch up widely adopted Western methods, but in one key respect her factories remain culturally alien to ours—the Japanese emphasis on large-family values was transferred to the factory. The manager feels personal responsibility for his workers as whole men. He helps provide housing, offers loans, may even help a single girl find a husband. And he provides a security guarantee: the Japanese, once hired, is typically hired for life, whether justified in economic terms or not. Is this efficient? It is not easy to decide, particularly since a part of the explanation for the ability of Japan to compete on the international market consists of the low wages she pays. It is not my purpose to make a case for the Japanese approach: as a matter of fact, it would not work at all in the United States. I merely point to it as an example of how differently work may become organized when values are different.

Let us next look at automation itself. The distinctive element in automation is the existence of a computer or other kind of information system which can give estimates of what is going on in the technical system and then make decisions as to what ought to be done to keep the system going or to change it in accord with whatever plans the designers may have. The most important point is that the programmed computer is expected to make decisions including those usually performed by inspectors and maintenance men.

When plans to automate are being made, they are often unpleasant to listen to. You hear phrases like "eliminating people" or "cutting out human operators" which sound very callous and inhumane, and often they are but they need not be. My own value position is close to that of Norbert Wiener[3] when he urges the human-use of human beings. The purpose of the machine is to liberate man from the indignity of having to behave like one. Men feel it proper to complain of doing a job a child could do or even a woman could do. How much worse to be doing something a machine could do and often do better. In my view machine work is slave work and giving as much to the machine to do as possible leaves for man the uniquely human tasks, though some of what

have long been thought to be uniquely human functions, for instance logic and pure reason, turn out to be easy to program into a computer.

What, in fact, will some of the displacement effects of automation be? Since we have so little experience to go on, the guesses reflect the bias of the forecaster. Management usually predicts very little displacement and labor union leaders a great deal. Or else forecasters attempt to be more modest and limit attention to a particular industry. For instance, Diebold[3] estimated that the manufacturing of agricultural equipment will become much more automated but agriculture itself will not. Walter Buckingham, Jr.[4] sees automation most likely in continuous flow industries, like oil refining, flour milling, and chemical production, and least likely if the product is what he calls "highly individualistic," if personal service is needed, if there is special advantage in small scale units, or if vast space is required.

All such analyses make sense, I think, but still contain a flaw for they assume present-day models of the processes whose future they are attempting to forecast. To rule out the possibility of automating agriculture, for instance, because vast spaces are required, assumes they will always be required. But in view of expanding food needs and the desire for a rising standard of living, surely there will be pressure to use less vast spaces in the future as in hydroponic or factory agriculture wherein plants grow on shelves one above the other. They are already in use and take no more space than agricultural machinery plants. Or to rule out activities where personal or individual service is needed is surely begging the question, for all one is saving is that personal service is *now* needed.

What this comes to is the need to allow for possible changes in public taste and that is not easy but I think one must make the attempt. The arts of propagandists, motivation research advertisers, and all the rest have their limits, but to assume no change in public taste, clearly seems to not allow for realistic possibilities. Even without those who are deliberately trying to modify taste, tastes will change on their own.

Another value assumption which is so much taken for granted that it is not even discussed is the belief that automation (and mechanization in general) are inalienably associated with efficiency. For efficiency, be it noted, is a value. There are many areas in life in which efficiency is not a value—making love, or spontaneous play, for example. But when we come to machinery it is taken for granted that efficiency rules supreme. Shall we discard that machine and use this one? The question answers itself: if it is more efficient, do so.

At the same time, this readiness to change in the face of a steady evolution of even more efficient machines gives to technology a sort of life of its own and we encounter strange language: persons speak of man's "lagging behind" his machines or even of creating "monsters"

he can no longer control. Such talk is dangerous and elliptical. It is dangerous because if man is powerless to control his own future then there is no point in trying to do so. And if there is no point, man will soon realize it and stop trying. It is elliptical because no machine operates without man's express permission. If the world should end not with a whimper but with a bang, it will not be any machine but man who has destroyed himself.

There is then, nothing inevitable about technological development. If a man is shown a model of a machine more efficient than one he is using and if he decides to go ahead with production for purchase of the new machine, it is *he* who has decided. If he replies, "My hands are tied; it is more efficient;" then he is simply saying he is committed to the value of the efficiency and by that token, to ignoring other values. Values always imply choice.

The assumption that efficiency is always the dominant value in technological change leads forecasters astray because it leads to the further assumption that automation is introduced in a company solely or mainly to reduce costs, especially labor costs. Hence, some say we may expect unemployment. But automation is often introduced to expand output without adding new workers. This may involve an efficiency consideration too, but sometimes management has no choice since the workers are simply not available, are untrained, or not reliable. It was not efficiency alone that led to the automatic bowling pin setter. Here is a clue of far-reaching significance in underdeveloped areas outside the U.S. For countries in a hurry to industrialize,—and which are not?—it might be faster and cheaper to build automatic factories run by a few imported engineers rather than undertake the slow process of introducing schools, teaching men what an incentive system is, teaching vocational and manual skills, etc., with the accompanying tragic break-up of native cultures and the rise of aggressive nationalisms.

Automation is introduced often not only to increase output but to do things that man cannot do at all, such as handling radio-active materials, performing elaborate calculations rapidly, or making many simple choices in rapid succession. At one university the results of advance placement tests in mathematics, English, and other subjects are administered to a Freshman class of 5,000 on a Monday and are made available to guidance counselors on Wednesday of the same week. It is this phenomenon that leads to the paradox that many have noted: automation sometimes leads to more employment. Once the machines are in, one finds one can do so much more than before but that doing it requires more persons. It is here that one encounters the end-to-end metaphor ("If all the cigarettes smoked were laid end-to-end . . .") We hear the claim by an enthusiast that if a certain problem were to be worked out with pencil and paper it would take a man 233 years to do it (without coffee breaks)! Such claims are mean-

ingless for the simple reason that if it took that long, the task would never be assigned. My point is that with automation you do new things you were never going to do before because you could not do them before. This may produce the paradox that you need more people than you did before—at least the absolute number may be larger.

Whether automation will lead to unemployment is, therefore, really uncertain; but it will certainly lead to displacement in many industries, as it already has. New jobs will be created and this raises the question of who will fill them, new already trained persons or existing workers who can be retrained. Probably both will be employed. We do not have much yet on the effects of retraining programs but what little there is, is worth examining. In the first nine months of experience under the Manpower Development and Training Act, training had been authorized for 9,074 unemployed workers: of these, 6,492 had been enrolled in retraining programs and up to the time of the report, 2,304 had completed the courses they were taking. Of these, 1,290 (which is 56% of those completing courses) had found jobs in fields for which they were trained and an additional 115 (or 5%) had found other jobs. The rest were still unemployed. It is not clear whether we should take comfort from those figures or not. You could say that 61% of those who completed their course-work found jobs and that is encouraging. On the other hand, when you add up these numbers, you get about 1,400, which is hardly going to make even a dent in the four million unemployed.

A number of interesting questions are raised by another series of studies which have attempted to evaluate particular experiences.[8] One is the experience of Armour & Co. which, in its last collective bargaining agreement, set aside a fund of one-half million dollars to be used primarily to retrain unemployed or displaced persons in the company. They had a chance to make use of the money when the Oklahoma City plant was closed and 433 employees were made idle. Of the unemployed, 170 applied for retraining. The were given a group of tests to see if they qualified and only 58 qualified for any type of retraining program.

Another experience was that of Bridgeport, Connecticut, which has an extensive program of retraining to attempt to raise the skill level of its work force. A little over a year ago Bridgeport had a 9% unemployment rate so there was every reason to get worried about retraining. They began their program in April of 1961. At that time there were 12,000 job seekers in Bridgeport. The retraining program was focused on semi-skilled machine shop work because an area survey had revealed that there was a need for 2900 additional workers trained in machine operation, assembly and allied occupations in the metal trades within the next two years. The Bridgeport office of the Employment & Security Division of the Connecticut Department of Labor undertook the job of selecting candidates. They formulated selection standards, pro-

cedures, and screen-tested and counseled the applicants. In the initial screening, three staff members reviewed the records of 3500 job applicants in the semi-skilled category. They selected 1,264 for interviews. These were persons who, on the basis of the written records looked like good possibilities. In addition, 879 turned up who looked like they would be good candidates also on the basis of the written records they had on them. They had a total then of 2143 as a potential, in the opinion of those who did the screening. Of this group 1,550 showed up. Of the 1,550 showing up, 560 were rejected as unsuitable; 401 said they weren't interested in the retraining; and the remainder, 589, were recommended for further testing for machinist aptitude and tests of other kinds. Of the 589 recommended, 201 failed to appear, 248 failed the test leaving 140 who passed and were scheduled for training. Of the 140 who were scheduled for training, 56 failed to start or never completed the course, leaving a total of 84 that completed the course.

To put it mildly, this is not a very encouraging picture anyway you want to look at it.[6] First was the low level of motivation to participate. In Armour there is a difference between 170 and 433 or 263 (61%) who did not apply for the retraining. In Bridgeport, if we restrict our attention to the 1550 interviewed, we have the 441 who said they were not interested, 201 who failed to appear for the test at all, and 56 that never completed the course. If we add those up, we get 658 (42%) who failed to take the steps necessary to get retrained although the facilities were available and they had been encouraged to go ahead. Of course, drop-outs or failures to appear may occur for all kinds of reasons—death, illness, decision to leave the community—but there seems no question that these percentages are very large and imply that there are many people that one simply cannot get to, apparently, even if a retraining program is available.

Some have pointed to factors such as the inhibiting effects of unemployment benefits, home ownership, unwillingness to move, apprehension about mastering new skills and other possibilities we know too little about.

A second problem is the testing program itself. This may have frightened some persons off or irritated some. Maybe tests are not necessary for some persons. Mature individuals are often impatient with tests. Lower class persons are suspicious of being tested anyhow, especially with pencil and paper tests. Perhaps the standards were too high. But suppose the tests were reduced to an absolute minimum and persons were not afraid of them. We still note that of the 170 tested at Armour 58 (34%) qualified in the opinion of the testers. Of the 388 that were actually tested in Bridgeport, 140 (36%) qualified. In other words in the opinion of the testers, of those who actually take the test only slightly more than one-third qualify. This suggests that a major reason for the limited success of retraining programs is that a

high proportion of those displaced not only have few skills and little basic education but are perhaps also least endowed with a capacity or aptitude necessary to absorb additional training. This is a very serious matter, if true. It may, however, mean a variety of other things. Perhaps the tests are too strict. Perhaps persons needed less aptitude on their previous jobs than they do on their new ones. This is a real possibility and an interesting one.

From my own research in industry, I have become increasingly impressed with the extent to which firms "carry" people. Once a person has been with a firm for a number of years, it is difficult to let that person go for humanitarian reasons, because of seniority controls, or because of a desire to reward loyalty. In spite of management's reluctance or inability to discharge older persons, technological change continues to occur. In order not to have to discharge a man, his job is permitted (often inadvertently) to become eroded. New tasks which should be assigned to him are assigned to others because he does not have the proper training. Tasks which he used to perform are shifted to others or become absorbed in a redesigned production line. But one day, management brings in a team of planners who design a method for automating the entire process of production. Such a wholesale change involves the total abolition of all existing jobs and the creation of a set of new ones to replace them. Most of the old personnel can be reabsorbed. But the person whose job has been eroded because of his lack of training is often not one of them. What I am saying is that automation is sometimes accompanied by dramatic drop in personnel which cannot be attributed wholly to automation itself. Rather, the decision to automate forces management to re-look at all jobs and then to eliminate some which cannot be included at all in the new production process. Actually, some, such as the case I have cited, might (from a purely technical viewpoint) have been eliminated long previously. It is often to management's credit that it has "carried" these persons that far. Automation has not itself eliminated their jobs but it has finally forced management to take a close look at them.

We have discussed only the problem of skill retraining. We have said nothing about other adjustment changes that are involved such as taking on a new job in mid-career. On that we have practically no data. Nor is that all. A major change in American values in the post-depression period has been in the direction of increasing concern with security. In line with this concern has been the increased emphasis by both management and labor on so-called fringe benefits, such as retirement and security benefit programs. But when jobs may be automated out of existence, no company may be able to offer with confidence a reward for life-time service or any other long term reward. The worker, pursuing his self-interest rationally, will, therefore, demand more *now*. If industry is unable to provide long-range security, the pressure on the government to do so will surely increase.

Those who seek a hint of the shape of the future without the risks of forecasting, may look at operations that are already fully automated. Good examples are power-generation and oil-refining, and much may be learned from them. The striking thing about them is that the workers are gone. The machines whir, the chemicals gurgle, but there is no accompanying shout of voices, no rehash of yesterday's ball game, no whistles as a shapely secretary goes by. A few persons are on the job but where are the rest? They have either done their work or else come in when break-downs occur. They are machine-builders, installers, programmers, controllers, and repairmen. It is striking that these activities are all highly skilled, and in most cases semi-professional or professional. Maintenance, for example, must not be identified with the usual "fixing" of today, such as changing a worn drill-bit or oiling moving parts: those kinds of maintenance will be built right into the machine so that it turns itself off, replaces the needed parts if any, and then turns itself on again. The limits of such self-maintenance are likely to be financially rather than technologically imposed. In one case management decided not to automate a drill-replacement operation when it discovered the costs would exceed the salary of a maintenance man for 50 years. Outside of such cases, the servicing and maintenance tasks that will remain will be those involving extensive tearing down of the whole line and its redesign—obviously professional activities.

Because of the expected need for such highly trained and professional persons, an enormous burden will be placed on educational institutions to produce them in sufficient numbers. One result may be the mechanization and automation of many educational operations themselves. This bothers some of my university colleagues. They worry about developments such as closed-circuit TV displacing them. Often there is the added claim that teaching in person is always better than films, tape, etc. This I find hard to believe. It is really a colossal conceit that leads any instructor to believe that without his physical presence for three hours a week the educational process will come to a crashing end. There are, surely, alternatives.

In my remarks I have touched now and then on the increase in the numbers of professional persons. I want to give explicit attention to this matter. The situation of the professional in American society will be very much highlighted by automation. And here we find ourselves on the crest of one of the great trends of modern times. According to the U.S. census, in 1870 slightly over a million persons were in professional service and they made up a scant 6.2% of all workers. By 1962 the number had grown to over 8-million and they now make up 11.8% of all employed workers. Such raw figures conceal a fundamental change in the makeup of professionals. Not only do we have more in the traditional professions— more doctors, lawyers, architects—we have wholly new professions or would-be professions such as those in public health, accounting, engineering, science, public opinion polling, social

work, guidance. Of these new professionals, the fastest growing are those in fields related to science and industry—chemists, physicists, engineers, designers, draftsmen, mathematicians. The coming of new would-be or near professions creates many problems. Professionalization is often a response to the problem of protecting the client: when we professionalize a field, we give its practioners visible badges for all to see. Yet that very action raises as many doubts as it removes. When society certifies a set of practitioners to be a profession, it also makes them into a monopoly in the public interest. Professionals are those to whom is given a mandate to do something vital for us—to heal us from our ills, save us from our enemies, build us safe structures in which to live, or get us justice in court. And, since their right to do these things for us rests on their presumed knowledge and expertise, we assume there ought to be a one best way to solve the problems that bother us. Yet it is the very nature of knowledge that it is never complete and hence always subject to question. Nor is it a matter of waiting for new knowledge for the challenges may come from those who do not wear the badge. And how is one to know whether they are right or not? To make things worse, those who do not wear badges often do not even listen to those who do wear them. So, does a scholarly question become a political one.

Professional authority is challenged in yet another way. Only a few are privileged to be self-employed; most work for a salary in an organization. This, rather than independent practice is the usual situation for the professional. In turn, organizations in the United States have been growing in size. Although most firms in the United States are small, they employ only a small proportion of the workers. More than half of U.S. employees are found in firms that have more than 100 employees in them. In this kind of an organization the professional finds, often, a challenge to his authority; that authority, resting primarily on his expertise, is challenged by the authority of a boss or line manager whose authority rests primarily on his position in the organization. A result is bitterness, misunderstanding, and low job satisfaction on the part of such salaried professionals.

These trends—the increased number of professionals, the increased extent to which professionals are working in organizations, the growth of larger and larger organizations—have had powerful effects on the ambition patterns of the youngsters with whom guidance counselors deal. For whom is the goal of owning one's business important? According to two careful studies,[7] that ambition was strongest among manual workers. Yet the studies also pointed out that for most it was a dream rather than a reality. An automobile worker, for instance, often thought of "kicking" the line and going up into the north woods to start a fishing lodge; yet he was most likely to try it when automobile sales were down and hence his own wages were low, and that, of course, is just the time when other people have little money to spend on fishing tackle

and rooms at his fishing lodge. So he goes broke and he returns. Yet he does not become disillusioned. There was always the feeling that there would be another chance. But these stories report this ambition mainly for the mature manual worker—not for the white collar worker. What of the youngster? By and large these studies suggest that his plan for getting ahead does not give high priority to owning his own business. I think it safe to say that most upward mobile youngsters these days want to go into one of the professions or into one of the larger business or governmental organizations where they hope to rise on the ladder. Of course, some hope to do both, but to be a professional means for most a life in an organization. Professional or not, those who would move up find that they now require a great deal of education. One of the safest pieces of counsel to youngsters who are unable to make up their minds about a job is simply to urge them to stay in school and go on to college. This is not very much guidance but it keeps open the whole question of career choice for there are worlds to conquer of which they cannot even dream. In fact, *any* very precise instructions are rather dangerous. Though youngsters cannot postpone decision-making indefinitely, the longer they stay in school, the more possibilities open to them.

In a real sense the ambitions of youngsters to join a profession or an organization are a response to the uncertainties of forecasting the future. For a profession is, as I have said, not merely a skill but a monopoly of the market, and hence has a built-in guarantee that it will not be automated out of existence. It is a temporary monopoly but for all that still secure, for a while at least. The youngster who joins the corporation is also in a sense passing on to the corporation his future security. If the corporation is a big one, the youngster can spend his time rising in it with little fear that anything will happen to the corporation itself. In an unstable world this may not be much but the youngster who moves in these ways will be able to claim he is "playing it cool."

In most cases of computerization, management is provided with far more data than it has ever had before. For example, Sylvania Electric which maintains a decentralized operation for the most part has its files centralized in one place in St. Louis. Some writers think that this may make management more rationalistic. Perhaps, but I doubt that data as such makes anyone more rational. Rationality would seem to come first. If one is rational, one looks for the data.

Computerization also has meant that a good many functions that management performs in many places have vanished—particulary scheduling and scrap disposal.[8] These decisions can be and are being automated. And this has the effect of making management a much more exacting business; the managers do only what the machines cannot do at least at present,—for example, motivating workers. Affected most

is middle management. A great many kinds of tasks that machines can take over are the sorts of decision which were the jobs of men in the middle management ranks. That trend raises many questions that we really have no time to talk about. But take one for instance: If the various ranks in management are the training ground for higher ranks, where will top management come from if this middle level is removed? I encountered this problem at one firm in an unusual form. In one project, there are three kinds of people—scientists (persons with MAs, PhDs, and the like); technicians (persons with some college, draftsmen and the like); and secretaries. That was all. Can a secretary become a technician? No. Can a technician become a scientist? No. No mobility at all. This is as rigid a cast system as anything the world has ever seen. So too with management. One has top management and one has a first level of supervision. Those in between become scarce. So where do you get people for top management? From the outside, I presume.

One effect of this problem is that of greater pressure on the first-level supervisors. Mann and Hoffman[9] examined a power plant which became automated, calling the old power plant "Stand" and the new one "Advance." They write, "The reduced number of personnel and the fewer job classifications in the operating sections of the new plant resulted in a reduction in the size of the supervisory force as well. With the elimination of the separate operating classifications of boiler, turbine, and electrical, the company was able to eliminate one level of supervision from the new plant. Stand had a foreman for each of the production functions—boiler, turbine, electrical—as well as an operating engineer who was assigned to coordinate the activities of the three groups. The operating engineer on each shift reported directly to the plant operations engineer, a member of the plant's top staff. In Advance, a single shift foreman was responsible for the entire operating force. He reported directly to the plant operations engineer. What effect this elimination of levels of organization had on the operation of the new plant, it is difficult to say. The men at Advance reported being significantly more satisfied with the amount of information they got about both the plant and the company than were the men at Stand. Reducing the number of people between the top staff and the employees appears to have eliminated one of the communication barriers between these two groups."[10]

They also attempted to examine the effect of the increased power of the foremen: "The reduced number of levels increased the influence of the foreman in that plant. The foreman at Stand appeared to have relatively little influence in the eyes of the men and the eyes of the foremen over how things were done in the plant. The foremen at Stand had even less say than the men, according to both sets of respondents. In Advance the foremen were seen as having as much or more to say than the men."[11]

The relative power of management over labor may also change. There is a famous story which has been attributed to Walter Reuther. It is such a good story that I decided to check on it. I wrote to the UAW and I asked Mr. Reuther if he, in fact, was responsible for it. He did not himself answer it but his secretary did, writing as follows, "Mr. Reuther relates the story to which you referred in your letter as follows: 'On my visit in 1950 to the first fully automated automobile engine plant, the Cleveland Ford plant, after seeing the acres of automatic machines with very few workers, a management representative asked me my impression. I told him I was much impressed by the technological progress that automation presented. He then asked, 'Aren't you worried about how you're going to collect union dues from these machines?' 'Not at all,' I responded, 'what worries me is how you're going to sell them Ford cars.' " The story raised the question of the relative power of these two groups. If automation displaces the traditional crafts and operatives—the semi-skilled, and unskilled, there is no question it will hit the labor unions very hard, at least in numbers, although labor unions do not always care just about numbers but about key industries. But assuming they do care about numbers—and they do as far as dues are concerned—it does not follow that management's power will therefore, increase. Automation means a shift to complex self-operating machinery. This kind of machinery is enormously expensive. Hence we find automated operations must be run 24 hours a day in order to realize the potential. This means that any breakdown or any interruption can be financially disastrous. The result is enormous pressure on the foremen. A study by Faunce[12] illustrates the problem with quotations from men in an automated operation: "It was better on the old job; nobody breathing down your neck. Over here it's altogether different. Just push, push, push all the time." Another one, "They never say 'Hello'; they treat you like a machine. They used to be friendly, now they seem to be under a strain." Another one, "The foremen at the new plant have too much to do and too much responsibility and they get tired and cranky. They'll all die of heart attacks."

The interesting paradox I suggest is this. Although the power of the unions may be affected; when you are running a 24-hour operation and when you are therefore beholden to your workers, they can begin to assume power over you precisely because breakdowns and interruptions are so disastrous. Although there may be fewer people working, those that remain may be more powerful than ever, with or without the union. The paradox, then is that whether labor unions are hard hit or not, the power of labor will be greater. We must remember too that much of this labor will consist of professionals who are difficult to replace and often have elevated conceptions of their importance. If this occurs, some members of management may prefer to bargain with a labor union rather than with professionals. Some managements in the future may

wish they had the labor union back. We may even see some deautomation!

Finally, let me quote from a brief summary by Floyd Mann[13] of a large number of studies on the internal effect of automation in firms. He tries to sum them up as follows: "First of all, there is greater risk (as I've indicated) under the new system. A serious error costs more. A typical error costs more in dollars and time. There's greater chance that an error will be detected and a greater chance that an error will be attributed—which means they can point the finger more easily. There's a greater interdependence and integration. Other's errors, both in the work group and outside have greater effect. Absences have a greater effect. There's greater contact with others in one's own group required, and there's a greater necessity for understanding the system. There's greater rationalization of the system. There's less choice of alternative means. Less work checked by people; more by machines. The work pace dictated more by machine or by others than by one's-self." He writes further, "Computer systems mean more rationalized organization; a curtailed distribution of job grades; a more centralized decision-making; higher performance standards; more accuracy in deadlines; greater job variety; more responsibility; an enhanced chance to learn; more pressure; less promotion opportunities;" and later he adds "a drop in employee and supervisors satisfactions and mental health. Changes in the readiness for change." He implies a heavy spending from the employee goodwill bank.

In my introductory remarks I referred to the alienation of guidance persons from their work. What I was thinking of was the kind of situation which I observed not too long ago in a midwest firm concerned with an oil refining operation. They run a three-shift operation with approximately four persons on each shift, plus one person who is sort of a roving technician to "spell" the others or relieve them. Only four men to run the entire shift, and this was a large operation. The four men spent much of their time examining dials, making changes and other adjustments. But the four men worked about a half-mile from each other. They could phone each other but this was the only communication between them. When I asked why the operation could not have been designed so that the four men could work in the same room instead of being so isolated, this was treated as a silly question. "There must have been a good reason," one of them said,—maybe costs." Perhaps. Even so, one could make a case for spending money and it would have been a very tiny proportion of the total cost of the whole operation. Morale and turnover are also costly. We have laws protecting workers from dangers to their physical health. Why not laws protecting them from dangers to their psychological or social health? It seems to me this is a role that guidance counselors can play. Besides counseling indi-

viduals, I suggest you could also think of becoming counselors to the society itself. You could say to those who design operations I have described or to those who plan to automate, "Let's consider also what it will be like to work in this kind of a system." This, it seems to me is a role which counselors can play which is quite in accord with their professional role and which might benefit clients, especially those clients most difficult to counsel.

References

1. See Robert Blauner, *Alienation and Freedom: The Manual Worker in Industry*. Chicago; University of Chicago Press, 1964.

2. Norbert Wiener, *The Human Use of Human Beings*. New York; Houghton Mifflin, 1950.

3. John Diebold, *Automation*. Princeton, N.J.: Van Nostrand, 1952, pp. 148-149.

4. Walter S. Buckingham, Jr., Testimony, *Automation and Technological Change*, Hearings before the Subcommittee on Economic Stabilization of the Joint Committee of the Economic Report, 84th Congress, First Session. U. S. Government Printing Office, 1955, pp. 32-33.

5. See Russell C. McCarthy, "Automation and Unemployment: A Second Look," *Management Review*, May, 1962: and Phyllis Groom, in *Monthly Labor Review*, Jan., 1962.

6. It is certainly possible that these experiences, being among the earliest, represent the failures to be expected in the early stages of any new program. A report made available since this talk was given only confirms the figures presented. The report of the experience with the Manpower Development and Training Act for 1962 states that 16,157 persons were authorized for training, 6,315 started training, and 1,433 completed training. *Manpower Development and Training Act*, Feb., 1963. p. 16. We would certainly have a more valid set of figures if we could wait a few years until a practical program has been completely worked out. But the very seriousness of the problem produces an impatience to wait and an eagerness to produce up-to-the-minute figures.

7. Seymour M. Lipset and Reinhard Bendix, "Social Mobility and Occupational Career Plans," I and II. *American Journal of Sociology*, 57:336-364 and 494-504, 1952; and Ely Chinoy, *Automobile Workers and the American Dream*. Garden City, N.Y.: Doubleday, 1955.

8. Thomas L. Whisler and George P. Schultz, "Automation and the Management Process," *The Annals of the American Academy of Pol. and Social Science*, March, 1962, pp. 83-84.

9. Floyd C. Mann and L. Richard Hoffman, *Automation and the Worker*. New York: Holt, 1960.

10. Ibid., pp. 55-56.

11. Ibid., pp. 59-60.

12. William A. Faunce, "Automation in the Automobile Industry," *American Sociological Review*, 23:301-407, 1958.

13. Floyd Mann, in Foundation for Research on Human Behavior, *The Worker in the New Industrial Environment*, Ann Arbor, Michigan: 1141 East Catherine St., 1962, pp. 18-21.

Technological Change and Vocational Counseling

JOSEPH SAMLER

In actuality we are concerned with the effects of more than automation. If nearly all work requires considerable skill, if the individual loses his job and has to find another kind of work, if he is out of work for long periods or faces permanent unemployment, it makes little difference to him whether the cause was the installation of automatic equipment, the introduction of a computer to control and make decisions for the automatic machinery, a science fiction-type of development in transmission of information for industrial processes, or the emergence of a new or different product or service.

TECHNOLOGICAL CHANGE: THREAT AND PROMISE

The literature on technological change and its effects is exciting and frightening. It is strange to come across the strong adjectives in the pertinent literature. Thus "the capabilities of these devices are unlimited. They contain extraordinary implications for the emancipation and enslavement of mankind."[13] Wolfbein,[25] in whose writing it is usually quite difficult to find the emotionally loaded word, states, "From the public point of view the implications become enormous." A Presidential Advisory Committee[16] refers to the "infinite promise of automation and technological advance."

The World's Goods But Few Jobs

The conviction grows that these seeming hyperboles are not that at all, that they are much closer to specific description than exaggeration. The capsules verify this point.

> Automatic machines, linked by transfer equipment, move engine blocks through a complete manufacturing process, performing 530 precision cutting and drilling operations in 14½ minutes as compared to 9 hours in a conventional plant.[19]
>
> . . . an automatic lathe . . . which gauges each part as it is produced and automatically resets the cutting tools to compensate for tool wear. In addition, when the cutting tools have been worn down to a certain predetermined limit, the machine automatically replaces them with sharp tools. The parts are automatically loaded onto the machine and are automatically unloaded as they are finished. These lathes can be operated for 5 to 8 hours without attention, except for an occasional check to

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make sure that parts are being delivered to the loading mechanism.[18]

In petroleum and chemicals, the story is almost ancient: as far back as 1949 catalytic cracking plants were turning out 41,000 barrels a day with instruments and only a few workers to watch gauges. In a Texaco refinery the computer controls 26 flow rates, 72 temperatures, 3 pressure levels, and 3 gas combinations.[19]

Ribbon machines make 800 electric bulb blanks a minute running without end, and requiring only one worker who stands by to make an occasional adjustment.[19]

The R. H. Macy Co. is trying out its first electronic sales girl. This machine is smart enough to dispense 36 different items in 10 separate styles and sizes. It accepts one- and five-dollar bills in addition to coins and returns the correct change plus rejecting counterfeit currency.[18]

In the electrical industry, output increased 21 per cent between 1953 and 1961, while employment declined 10 per cent.[19]

The following changes occurred in a large bakery after the installation of new automatic equipment: One man operates the equipment that moves 20 tons of flour an hour from railway cars to bins, compared with 24 men who used to move 50 tons of flour into the plant in 5 to 6 hours. In the bread-baking department, the number of workers on each shift was reduced 50 per cent and capacity was increased 75 per cent. Jobs in the wrapping department were cut 70 per cent while there was a 75 per cent rise in capacity.[11]

With the aid of an electronic-computer installation for the Bank of America's mortgage and installment-loan operation, 100 employees are now doing the work of 300.[1]

In the assembly of television components at the Admiral Corp., condensers, resistors, wire jumpers and tube sockets are inserted mechanically. By using automatic insertion and printed circuits, over 400 hand-soldered connections are eliminated.[1]

A completely automatic plant is producing mixed and ready-to-use concrete for the Cleveland Builders' Supply Company. Operated from an electronic control panel, the plant can produce and load into ready-mix trucks any one of some 1500 different mixing formulas that may be demanded. This automatic plant has a capacity of 200 cubic yards of concrete per hour and it uses no manual labor at any point in the process.[1]

Aside from the doubtful miracle of agricultural productivity and farm labor, nothing is more compelling than what has happened in the coal

mines. Fifty years ago 700,000 American miners were able to mine less coal than 140,000 dig today. The prospect is that by 1980 coal production may double without any increase in the number of miners.[8]

From these instances and many that are similar the conclusion seems clear that unemployment inevitably accompanies technological change. Although this seems to be the preponderant opinion the conclusion is too facile. Conservative economists, Brozen[6] for example, urge that automation makes as many jobs as it does away with. Perhaps the considered attitude is Gross's, that the resulting unemployment is uncertain but it is certain that automation leads to displacement. When the assembly line worker in Des Moines loses his job as a result of technological change, it does not help him to know that in Chicago someone was hired as a programmer or computer serviceman. But the extent of such new employment is not known. Despite the many books and articles, hard data are not available. "The Manpower Revolution", states the Report of the Subcommittee on Employment and Manpower,[21] "like the industrial revolution, is first and foremost the product of technological change. The nature of this change, however, is little understood, even by those who have had most to do with it."

This is presumably why extensive research in this area is being financed by the Office of Manpower, Automation, and Training, and why a Presidential Commission outside government has been appointed to study the impact of automation on production and employment.

This is the frightening part of what is before us. The loss of job, the inability to find work, the assignment of fault by the individual to himself, the seeping away of self respect, the need to live on a minimum budget or to have to scrounge for food and shelter, these make up the fear.

A New and Different Kind of Life

But it also holds infinite promise. Since the gates of Eden closed and man has had to earn his bread the hard way, he has longed for time and energy to explore his own humanity. Gross puts it epigrammatically in urging that the purpose of the machine is to free man from having to behave like a machine.

Technology is a most potent agent for social change. Yesterday's history relates what happened following a much milder form of what we now face. The industrial revolution put man into the factory and brought about mass production. Luxury was made possible for more than a limited few. The machine replaced the slave and the slave came closer to assuming the attributes of his humanity. Today's reduction in hunger, alleviation of disease, increase of the life span, are the results of science and technology. But, sociologists are quick to point out that the innovations of technology brought new problems to the fore. The

incredible toll of human life on our highways resulted from the invention of the automobile; mass production resulted in the alienation of man from himself on the assembly line.

A tremendous portal is swinging open. And with its opening other doors further on are at least unlocked. What is the prospect? The child of today as a productive citizen will be trained to optimum capacity but will be employed for a twenty-hour week. He will travel to the furthest part of the world in hours at minimum cost. His inexpensive clothing, made of miracle fibers, will be discarded after being worn a few times. Away from home, he will communicate with family and friends by wristwatch receiver and transmitter. At his desk or from the public booth his telephone call will be visual as well as aural. He may still call it a library but in fact it will be a central information retrieval center and he will get the reading he wants at home through his viewer. If the family tires of this there is always TV, wall sized, in color and three dimensions. His world will use fuel cells for portable electric power; solar energy will be available; nuclear power will produce more than is put into it for a wide variety of purposes including travel at least to the moon. The incredible laser beam will have opened new fields of knowledge and will be widely applied. Through 24-hour a day satellites, no part of the world will ever be isolated again. The oceans will be farmed and the ocean bottoms mined. Micro-organisms will be used widely in industry. DNA will have begun to yield its secrets and the control of genetic characteristics will be on its way.*

Is this fantasy? Its beginnings are all around us. Moreover, since the rate of accretion of knowledge is increasing, the picture is modest; we cannot note what is around the corner; and we will yet turn many corners.

To Find Ourselves

What then will confront man? The problem may be one of a leisure which will be unwelcome to many and which others will be unable to use productively. Nevertheless, the leisure will be there and with it the chance after all these centuries, to open yet a further door and for man to explore the illimitable areas within himself. These are ranges and depths as yet unexplored and unknown. What a leisured class built upon slave labor could do in ancient Greece in the arts and in philosophy, a society built upon machine labor, with greater resources and accumulated knowledge can emulate and perhaps surpass.

The hope is held out that far from being an aristocratic elite, the new leisure class will be democratic in composition and temper. With increasing time to himself, man is more than ever in need of improved

*Most of these ideas come from Seaborg, G. T. Chairman, U. S. Atomic Energy Commission, ref. 18.

taste, more diversified interests, more constructive social values, a more active sense of citizenship, and higher individual ideals. We have no measure of human potentialities for the use of leisure because they have never before had adequate consideration in mass education. The time has come for broader and deeper cultivation of the arts, sciences, and humanities. Imaginatively taught, they can help toward understanding urgent public questions and give a meaningful direction to the use of leisure.[26]

The problem in at least one important area is self-fulfillment, and work is not necessarily the only way for this achievement. There is evidence that nearly all of us do not know how to believe in ourselves except through work for pay. Beyond a kind of satisfied complaining we do not believe it is right to use leisure for more than temporary relief from work. If we trace the connections through the centuries[22] the man-made nature of these sancrosanct and deeply held beliefs becomes quite clear. Thus very many who are out of work feel guilty and unworthy. It is a by-word that many who retire from work feel useless and out of the stream of life.

THE EMERGING LABOR FORCE

The Manpower Revolution

The primary function of the vocational counselor in performing his task is to help the individual relate to the working world. It has been carried out well in relatively few instances. For identifiable reasons duties in vocational counseling have become second class. The therapeutic function, involvement in personality dynamics, has become the preferred mode. Brayfield,[5] Tyler,[28] and the present writer[17] have urged that close and constant appraisal and understanding of the working world is the core of the vocational counselor's contribution. This does not mean that this is not a psychological task. The view of the worker as more than an economic entity, as it is perfectly obvious he is, requires psychological insight and understanding at a sophisticated level.

In a relatively stable industrial setting, in which, for example, the blacksmith had a generation to adapt to the disappearance of his trade, it was possible for the counselor to pay pro forma attention only to the working world, its requirements, its satisfactions and the variability of both in different kinds of work. That world is fast disappearing. For the specific client, it will be critically important for the counselor to know that the work setting of the console operator is such that here and there he is requiring "lonesome pay."

The nature of the technological change is first on the list of counselor understandings. Chief among these is understanding of the impending manpower revolution. This is no longer a term used for its

dramatic effect. It appears and reappears in the literature and is carried as a basic title in the ten volumes of the Hearings of the Sub-committee on Employment and Manpower.[20] The concerns of vocational counselors flow from these data.

This is a revolution with a history as the following data reveal:[25]

	Percent of Labor Force		
	1910	1950	1960
All workers	100%	100%	100%
White collar	22	37	43
Professional & Technical	5	9	11
Proprietary & Managerial	7	9	11
Clerical and Sales	10	19	21
Blue Collar	37	41	36
Skilled	12	14	13
Semi-Skilled	14	21	18
Unskilled	11	6	5
Service	10	10	13
Farm	31	12	8

The white collar worker's rise to a plurality position is clearly revealed. Also quite evident are the enormous inroads into unskilled non-farm labor as well as into the farm labor force. The stability of the skilled craftsmen group as a whole (but not for all occupations in it) is a point important to counselors and their clients. Current observation and projections for the decade ahead measure this swift tide.

The President's Manpower Report[12] carrying the Labor Departments revised interim estimates informs us that the total population is expected to increase from 181 million in 1960 to 226 million in 1975 with a concomitant increase in the labor force from 73 million in 1960 to 93 million in 1975. Professional, technical and kindred workers will increase from 7.5 million in 1960 to 12.4 million in 1975 for an incredible increase of 65 percent. Laborers (except farm and mine workers) will decrease in their proportion of the total labor force from 5.5 percent to 4.3 per cent. Agricultural workers, already the most outstanding example of technological change, will decrease a further 28 percent. Service workers are projected to increase from 8.3 million to 12.5 million. The increase in operatives and kindred workers of only 18 percent is considerably less than the increase in the total labor force. The same point, though less dramatically, can be made relative to sales-workers.

It is data of this character that impelled the President's Manpower Report[12] to note that "important shifts of manpower are in process with forced readjustment for large numbers of workers and serious implications for the education and training both of the present work force and of young people still in school."

If, as is clear, mechanical means more and more will replace human muscles, what happens to unskilled and semi-skilled workers? The answer is that there will be fewer and fewer jobs for them. The pattern this group will follow is exemplified in the history of agricultural labor. Unlike the story of farm labor, however, much depends on whether the economy as a whole is in sound shape. If there is a comfortable margin of income, needs will emerge, very possibly leading to work opportunities for this group as waiters, bartenders, cooks, gardeners, home maintenance men, retaining wall builders, home carpenters, and the like.

The High Premium on Training and Skill

At the other end of the distribution is the fantastic story of what has happened and will continue to happen to professional and technical personnel. The occupational pattern in 1900 which showed one of every three male workers employed as laborer on or off the farm required a relatively low degree of educational attainment by the labor force. This is contrasted with a job pattern that showed in 1960 one in three male workers engaged as either a professional and technical person or a skilled craftsman and, therefore, requiring a significantly higher degree of education in the labor force.[26]

The Labor Department[12] reports that more training is required for the maintenance positions where technological changes have been made because a combination of electronic, electro-mechanical and sometimes even hydraulic operations are involved. For this reason many instrument repairmen and business machine servicemen need post-high school education in engineering fundamentals, mechanics, or electronics, in addition to intensive occupational training. The Report states that maintenance electricians and appliancemen will need more technical education in order to handle a growing number and variety of electronic devices. In the scientific and engineering professions, aside from accretions of knowledge in all fields, new specialties have come into being, for instance, cryogenics, bionics, ultrasonics, computer technology, and micro-electronics.

When in the new world of technological change the employment trend is analyzed occupation by occupation in terms of probable job requirements, or, and this should not be discounted, of employer predispositions, the basic direction of the requirement for workers with more education and greater skill is quite, perhaps disconcertingly, clear. The point concerning employer predispositions is made at some hazard. In terms of job skills it is not really known that high school graduation is a necessity; it may be that properly or not employers have bought the idea that this is so. Perhaps many of these jobs could be accomplished by non-high school graduates. Looking at it the other way, the uncomfortable question arises whether if the 7,500,000 youth estimated to

leave school is the decade prior to high school graduation, did indeed stay in school, where would their jobs come from?

Another way of opening up the relationship between training and skills and employment is through assessing the situation of the unemployed. The relationship is only too clear. For 1963[12] three quarters of male professionals worked an entire year at full-time jobs as did two-thirds of male white collar workers. However, this is true for only one-third of laborers. In 1963 the average unemployment rate for the nation was 5.7. For the 14-19 age group it was 15.6. The deficiencies in the education and training of Negroes is too well known to require comment. It should not be surprising, therefore, to find that the unemployment rate for this group, for 1963, is more than twice that of white workers. Comparison[12] of unemployment rates between high school graduates and dropouts reinforces the same unhappy point. The data reveal that only 8 percent of the graduates but 14 percent of the dropouts were unemployed. This group, The President's Manpower Report notes, are likely to form the nucleus of the future hard-core unemployed.

Wolfbein[25] states that "whether it be the unskilled or semi-skilled, the young school dropout, or the older man who also has a high rate of long term unemployment, one of the great common denominators which ties them all together is lack of skill."

THE EMERGING COUNSELING PROBLEMS

The Meaning of Occupational Information

All of this is the new background for viewing the work of the vocational counselor. A number of issues will be presented that bear on his work and on the profession. The counseling issues selected for attention flow out of the special problems presented by technological change and the manpower revolution. Normal counseling activities—helping clients in their development toward self determination and in assuming responsibility for self—are taken as understood.

Counselors need labor market data about the changing occupational structure and authoritative analyses about the nature of the job. This means not only that they require the tried and true items reasonably well carried in the standard occupational brochures, but also psychological and social characteristics of various occupations.

For example, the informed commentators on the automated scene report a reversal of the trend to decentralize managerial decisions. Moreover, the range of determinations now made by middle management can be made more authoritatively and very much more quickly on the basis of computer treatment of data.[2] Its import for the counselor lies in the information he provides the bright young men heading for business

and industry whose career lines include stages in junior executive and middle management echelons.

The data shows that the need for skilled craftsmen is stable and point to a projected net increase of 2.3 millions in skilled workers for the decade with a total need of 5 million, taking into account skilled men leaving the occupation.[27]

The outlook for most of the skilled worker occupations is optimistic. The same point may or may not be made, for instance, about the service occupations. It is demonstrable that jobs associated with eating out, the protective service, and health service occupations have been increasing. Will they continue to increase? Will technological change and automation affect these occupations? We do not know, we cannot be sure. What is certain is that in helping the individual evaluate the educational and occupational choices before him, the counselor must have available for him current and sound information, including identification of what is not known.

We are becoming aware of the need to identify the psycho-social aspects of work — for instance, the particular culture of the shop, the status characteristics of a given position, the way in which personality needs can be met in an identified work setting. It is important that these understandings be sought for the new range of occupations and work settings. The "lonesome pay" of the dial watcher referred to earlier is a case in point. The fact that the skilled maintenance worker will be relating much more to machines than to fellow workers is another. Another is the intolerance of the equipment to allow for the coffee or cigarette break or just plain goofing off for brief periods. All these and others may affect worker satisfaction as much or more than pay, hours, or advancement possibilities. With new work settings and work structure affected, the whole area of job satisfaction must be re-examined. With job change, according to some authorities, much more the rule than the exception, what happens to the personality-based drive for security by some clients? All of this is important to the counselor not only in terms of the considerations to be put before his client but also because a proportion of those who are dissatisfied and unhappy at work may turn up in his office.

Training to Optimum Capacity

This issue has to do with the problem of optimum use of human potential. The need in the economy not only for skilled personnel but also for high level skills seems quite clear. Noting that automation requires trained and educated people in unprecedented numbers, Drucker[10] estimates that the quantitative need alone will be so great that eight or ten million college students expected fifteen years hence will be barely sufficient. He cites a large manufacturing company which estimates that after it is automated it will need *seven thousand college*

graduates a year just to keep going; today it hires three hundred annually. A current Bureau of Labor Statistics study for the National Science Foundation[15] reveals that fewer than 765,000 newly trained scientists and engineers will become available to fill more than one million openings for them between 1960 and 1970.

That the economic rewards are there for the individual who uses himself truly to capacity seems reasonable to assume. This is reinforced, moreover, by psychological tenets that it is self-fulfilling for the individual to use his capacities as fully as possible.

The question for the counselor and the profession is to what extent this should become a value commitment held in awareness, put on the table with the counselee, and strongly supported by the counselor? Before this point is reached, should it be decided affirmatively, there is much that can be done in counseling. For example, when support of training is involved as in rehabilitation programs, budget tends to set limits on the extent of training to be provided, if training is to be provided at all. Minimum employment goals are set, at relatively low skill levels, for the perfectly understandable reason that in this way more people will be served. There is no problem here that increased budget will not solve. The same reasoning precisely is applicable to providing funds for scholarships and student loans. There are other and serious complexities here, to be sure, but this formal part of the problem at least is capable of solution.

The principle of realization of potential requires that the talented baccalaureate science major go on to his doctoral degree. It also calls for realization of maximum skills on lower levels. It is applicable on all levels, and for all groups. It has reference to youth with high potential who should go on to college but whose expectations are far different. It is pertinent with the members of special groups—women, the disabled, members of disadvantaged minorities. With all of these and others, there is the opportunity to increase our resource of manpower skills.

Planning What Cannot be Planned

Another aspect of training to optimum capacity may be said to be training to diverse capacity, perhaps to capacity in each of a number of different lines. The point made by various observers in this context relates to the need to plan for change, as a result of technological innovations.[9,12] One way of meeting this problem is to avoid emphasis on specific skills and to develop instead basic capabilities. To the extent that this means emphasis, for instance, on the underlying principles of science, on a wide acquaintance with the humanities, it is quite clear. If industry were to assume responsibility for more than vestibule training the schools could limit themselves to so-called basics. But how far industry is willing or able to go is indeterminate as are the difficult definitions of what is general training and what more

specific. Also inevitability of change can be communicated as a matter of basic attitude, of mind-set and expectancy. However, we ought to be more certain at least of our thinking before we start to implement in program terms, which in any case may present more problems than are allowed for in the theoretical position. There is thinking which at its extreme seems to say that there is no sense in specific vocational planning, for instance, in adolescence, since we do not know what kinds of work will be available when training is completed. However, it is most doubtful that the change will be so great for the majority of work, as to make the occupational picture unrecognizable.

When there are few clear leads for training and eventual occupation it has always been sound practice in counseling to advise young counseling clients to delay any forced choice. When he is unable to decide which fork of the road to take, it makes good sense for the individual to stick to the main road as long as possible. The clear advantage here is that such persons can complete high school and go on to college, opening up new possibilities for them.

Stripped to its bare bones, counseling can be seen as helping the individual confronted with a problem to weigh the choices available to him for its solution. So regarded, it also ought to be clear that in any single problem situation: change of job, choice of "track" in high school, dropping out of school, choice of college, meeting seemingly inordinate parental demands, and many others, much more is involved than merely the solution for the immediate problem. If the experience is attended to in terms of the basic process, it becomes a learning situation for attacking other similar problems — it becomes the model. Probably we have not deliberately used counseling for choice-making to foster learning in how to make choices, but the need seems inescapable. This learning is in itself, and for obvious reasons, highly desirable. Thus, the individual helped initially with a choice-making problem can face the question of job change whenever it occurs, in travail to be sure, but at least knowing that there is a way to attack it and that he has the ability to do so. The immediate difference may be between despair and discomfort. The more important difference relates to personal growth and maturity. This exposure to learning choice making is also necessary because the alternative is very difficult: to provide counseling service at every job change, at every point where more than ephemeral problems are involved.

Client Development Through Training

The long-range solutions to the vocational adjustment problems facing underprivileged youth lie in prevention. While the counselor is greatly concerned, he has no mortgage on the problem. Indeed it is a heartbreaking problem, and to say that the schools need to change is to say very little. Basically, the community should change through achiev-

ing greater understanding, diminshing distrust, providing opportunity, and making the values it professes to offer to such youth capable of achievement. If these community changes are effected, the school's problems may prove to be capable of solution. In these circumstances, the counselor's role is perhaps mainly that of agent, presumably more specifically trained than are others in understanding the perceptions and protest of today's underprivileged and bitter teenagers. We may yet have to learn the hard way under the lash of riots, as has happened recently in a number of cities.

As an agent for change the school counselor can attempt to help others construct the educational experience which in terms of the need for basic social change, still seems a second best approach. In the absence of such change in orientation and values of Negro youth as will overnight help them to adjust to the school as it is now, systematic efforts should be made and are in fact being made, to adjust the educational situation to fit more closely the needs of disadvantaged youth.

One such important but neglected possibility is the work-study program. Long known and never sufficiently extended, this is a program that the counselor can initiate, push, and assist with. In addition to providing a better framework for learning, work assignments carefully selected may be for many the first specific instance of systematic assistance extended to disadvantaged youth by the major culture.

Whether it is through a work-study program, the array of training courses available under the Manpower Development and Training Act, the courses and experiences in the skill development centers under the Economic Opportunity Act of 1964, or the usual school program, one major role of the counselor is well established. This is to assist the client in his development by helping him select and enter that school or course of training most appropriate to his developmental level and needs. There is involved in this process a body of theory and a methodology on the basis of which the individual is helped to assess in his own interests the various choices available to him. This is a simple sounding statement, but trained personnel are aware of the complexities it carries. The least ambitious information the counselor must have is comprehensive knowledge of resources, in this case training resources. Since increasing the range of choices is part of the counseling task, and since the client cannot choose what he does not know about, not to have such information is inimical to the client's needs.

The "Unmotivated" Client

The prescriptions for success explicit and covert in the culture—to achieve is to be respected, success follows hard work, to be "someone" one must be popular—are frequently enough unreal, even though education will continue to be a great highway for achievement and status for many. For others, many underprivileged minority group youth, the

promises seem only false. It is essential to provide tremendous programs of the kind authorized in the 1964 Economic Opportunity Act and under MDTA. Many have been selected for classes under Manpower Development and Training and no doubt there will be considerable numbers of applicants when the recruiting offices are opened under the 1964 Act. But what of those who do not apply? On the face of it they are different from youth interested enough to apply, follow through, leave home if necessary, and subject themselves to a discipline of training.

Those who do not apply are in the situation of the unwilling client, a problem consistently and quite successfully ducked by counselors. In fact, one criterion for successful counseling is said to be the willingness of the client to seek help. It is difficult to separate the unwilling from the unidentified. These are not students who knock on the counselor's door. If seen at all, they are seen in the exit-interview, generally too late to do anything. Many in this group may not even reach the secondary school. Nearly all, in all probability, are in the two and a half million who in this decade will not complete the eighth grade. Whether it is part of counseling role actively to seek out proper applicants, pursue case finding, and be more than only responsive is a very important question. No pat answer to a most difficult problem is intended in these lines, only underscoring of the problem and the strong urging that it receive attention. Essentially this is a problem in motivation. Seen this way, its difficulties become more evident since we know that no person can be motivated for another. How then is motivation energized? How are the presumable threats to productive functioning removed? How can we help youngsters with no significant experience in the validity of planning for oneself make the sacrifices in the present which investment in the future may require?

Concern with the unmotivated person is by no means limited to youth. Two instances cited by Gross are salutary. In the first instance, 433 employees were made idle when Armour & Co. closed its Oklahoma City plant. We need to focus attention on the fact that of 433 employees, only 170 applied for retraining. That of the 170, only 58 qualified is especially important for us and will be discussed later.

The second disconcerting experience, and surely they can be multiplied many times, occurred in Bridgeport, Conn. When of a total of 2143 invited for interviews to select trainees, 1550 showed up, of whom 441 said they were not interested and 201 failed to appear for a qualifying test. Out of 2143, therefore, 1235 were not interested or did not follow through.

The individual's experiences with the agency offering the training opportunities are of moment here; at least his perceptions of his experiences with the agent are an important consideration. For example, if his relationships have been unhappy and hostile, lack of response to

an offer would be understandable. If this is generalized to stand for the individual's life experiences and the meanings he has attached to them, a great deal (but not all) of the mystery of lack of motivation might be explicated. With the economically and socially disadvantaged, basically this is a societal problem but to an extent, counseling can help through group and individual procedures. Perhaps a beginning will be made under the Economic Opportunity Act through the Youth Advisor program. According to the official releases[11] the Youth Advisor position was created to reach out "to young people in disadvantaged environments who have never been in a local employment office and whose aspirations and motivations do not include training for or holding a job." No doubt the interest, sincerity, even youth, of the Advisors will result in some good things. However, on the face of it, this is a job for personnel at a very high level of competence and training.

Qualifying for Training: The Doubtful Absolutes

Even with the best we are ready and, perhaps, able to do, the outcome is quite uncertain. Taking into account the skill requirements of the labor force thirty years hence, and contrasting the progress made by white and Negro in education, Bell[4] believes and underscores the serious point (stating that he is perhaps overdramatizing in order to highlight the case) that class society in the U. S. will be predominantly color society. In supporting his fear, he pulls together data in part already reviewed in this paper concerning the great proportion of lower class jobs occupied by Negroes, the high rate of functional illiteracy in the group, the high proportion of Negroes among school dropouts, and their high loading among the unemployed. It is the possibility of this hazard that requires the utmost in efforts and expenditures, indeed, as Bell fears, if there is time to do so.

Of the 170 who applied for training when the Armour plant closed, only 58 qualified. In the Bridgeport, Conn. experience, of 388 that were tested, 140 qualified. In each case about two thirds failed to qualify. These instances should stand as thoughtful reminders of the qualification hurdles we have set up almost universally for entrance into training and for employment. They should stand as reminders for our orthodox professional living, wherein we hew to hypotheses as principles and to our ways of thinking as immutable. This issue can be made as dramatic as anyone wishes, the point being that more likely than not it is counselors who determine the qualification standards.

It is possible to be very discouraged at the manpower prospect. On the one hand, the new technological world will demand great capacity and much skill. This is encapsulation, of course, and inevitable variation will occur but let us accept it as generally true. On the other hand, there is the given distribution of capacities and abilities. In a world with few work outlets for the minimally talented, what is to happen with the

lower end of the distribution? At any given cut-off point there are very sizable numbers involved. Those who were found not qualified in the Armour and Bridgeport instances presumably fall in this group. Their name may be legion.

These questions have been raised before, somewhat tentatively, for instance, by Auman,[3] Bell,[4] and Gross (in his paper in this publication). As far as is known to the present writer, they have not been raised so to speak within the family or very directly.

The problem of training qualifications and standards should be put on the line. We say that youngsters in the IQ range of 60-75 generally cannot learn to read material beyond the third or fourth grade level. We really mean that given present teaching conditions and methods and our strong beliefs in the sanctity of the Wechsler or the Stanford-Binet, the boy so described will not learn to read beyond a given grade. This instance should stand for all situations where particular instruments or a given methodology instruct us about the appropriate prediction and serve to shut the admissions door. It is quite understandable that we tend to forget that the truths we have are provisional by definition.

The question (and Diebold asks it also in his paper) has to do with the extent to which a person can be retrained and what the critical variables are. Suppose in the case of the retarded we had classes of 3 or 4 rather than 10 or 12; suppose retraining was on an on-the-job basis rather than mostly in a classroom, what might happen then? We know too much now to defend the position that human capacities are fixed. McClelland's work on supplying achievement motives is well known although it does not yet seem to have caught on. Bruner[7] feels that any subject matter can be taught effectively in some intellectually honest form to any child at any stage of development. Even if we discount the reports of education in Russia, the effects on children's learning of assigned role and implicit expectations cannot be dismissed.

The responsibility of counselors lies in the fact that very frequently we are the people who hold the keys. We unlock the doors. The comforting labels of "false positive" and "false negative" only express our doubt. None of our educational and counseling practices should be beyond questioning. The point is not that with different premises, new approaches, and other techniques we will accomplish miracles but that *some* change *can* be brought about. Aptitudes and capacities are trainable up to a point. Whatever it is, intelligence may or may not be genetic but its development is strictly a product of culture as are the instruments that measure its functioning. Even modest increases in aptitudes and capacities would greatly ease the training problem.

Counseling for the Social Structure

Somewhere in his development the professional faces a difficult problem. Given a monopoly by society, a profession can address itself

to its technical and professional problems: maintaining standards, furthering knowledge, policing itself, and serving its public. As it reaches maturity it begins to be concerned with the social context in which the work of the profession is done. This is the situation of the nuclear physicists with respect to nuclear discoveries or psychologists in international peace. Is counseling psychology approaching such a crossroad in its development? We do not hold a mortgage in worrying about manpower problems, the country's welfare, or its future. But our task has to do with the optimum use of potential in work, the opportunity to be productive, securing as great a measure of satisfaction from job and life as possible. Therefore, we are warranted in being particularly alert to what is going on in the economy and to offer considered opinion on social programs. There will be many who will disagree.

There is plenty of cause for worry. In addition to the profound effects of technological change, 26 million new young workers are coming into the labor force in this decade. Short of full employment and an unemployment rate a good two percentage points lower than it is now, where will these young people work? Should counseling personnel address themselves to this problem and make themselves articulate about it? Should we say, with advice from economists, that the private sector cannot do it all? Should we urge as a profession that government must cushion the effects of technological change and of this tremendous increase, 40 percent more than in the last decade, in the number of young workers?

If we get into a bind as well we may, what should be our stand relative to women workers? One third of the labor force is made up of women and in many settings their work may be greatly affected by technological change. It is not unlikely that the major focus of retraining will be for men as the family breadwinners. In such an eventuality should we concur? Should our special awareness of the need for talent compel us to urge special provisions for marriage-career patterns for women? Would this mean that we should take a definite stand about basic preparation prior to child bearing? If and when the work-week is shortened, the problem of women at work will be easier to solve. But even now are there career patterns that might utilize the hours at home of trained and capable women? There must be such possibilities—art illustration and limited practice of medicine, come quickly to mind as possibilities.

There are other minority groups. The disabled, in the perceptions of employers and for a complex of reasons nearly always marginal workers, present a mixed picture. To the extent that work becomes more sedentary—e.g., console operator, quality controller, systems analysts, programmer—physically handicapped workers will be less disadvantaged. On the other hand the set convictions of many employers operating in a relatively free labor market may work against their em-

ployment. Presently rehabilitation programs which emphasize narrow training aiming at highly specific jobs will need revaluation.[25] It also seems clear that those with histories of serious emotional problems as well as the physically handicapped who have made a more or less sound adjustment at work, may be quite troubled at the challenge of change and at change itself. It is hardly necessary to reiterate that in harvesting high skills we cannot afford to neglect a resource that has proved itself many times. This is as true of course, for women workers and racial or ethnic minority group members as for the disabled.

There is no problem brought about by technological change that cannot be solved under full employment. The question is, will we have full employment? Informed opinion is that we will not. The question for counselors is whether, from our very special position, we should add our testimony concerning the need for government intervention in extending employment possibilities. We can do a certain amount of table pounding or we can maintain a passive role. As a discipline we have come out of the school system, a sector not particularly articulate about social needs. It would be unfortunate if we maintained a dignified academic distance.

In taking a stand we will have to consider the nation's unmet needs at least in health services, recreation, housing, and education. Through government support these needs can be the basis for important employment programs. It is almost fortunate, Gunnar Myrdal[20] states, that we have such tremendous amounts of work to be done in our economy. The idea has to be faced that these may be permanent or at least extended programs, and that they should take various forms, as part of ambitious work-study plans on a secondary, post secondary, and college level. They might be limited to particular age groups: the older, very young, minority groups, or disabled. They could be used for try-out purposes as part of long range motivational exposure, as an aspect of counseling and education.

The Truths We do Not Have

Much of what we do in guidance and counseling, not only in the express train rush of the emerging programs, but also in our long term work in schools and hospitals, is based on hypothesis and supposition. This is not to tear our work down but to be realistic about it. Very much the same thing can be said about nearly all disciplines in the social services, for instance, psychotherapy and social work. The problem is that our sciences are young and unsophisticated and our object of concern is man in all his complexity. The fact is that many look to us for help. Clients do so by definition, but so do the policy makers.

All of this underscores our need for finding out what works, under what conditions, to what ends, and lest we get lost in empiricism—why it works, and how we can evolve methodology for ends we predetermine.

The object in this, as in other sciences, is to learn how to control and predict, and to do all this, moreover, with freedom for the individual. This must be one of the most difficult tasks in the world.

Of the large charters and huge funds becoming available to us some part, relatively it will be very small, should be set aside for research. This need not mean that every worker, from newly appointed counselor-aide to head of program, should be engaged in research some part of his time. The opinion is ventured that it will be enough if they maintain a scientific spirit about what they do and how they do it. The job of research should be done by personnel qualified to do so, conversant with the problems of counseling, skillful and ingenious in methodology, and aware of problems in most urgent need of attention. There are parallels for this kind of orientation in medicine and psychotherapy.

The Problems of Being in Charge

Support of guidance and counseling has become national policy. It is evidenced in hearing the Assistant Secretary of Labor say so in a public address,[14] or the Secretary of Labor[20] making a comprehensive manpower policy depend in part on "an effective vocational guidance and counseling program beginning in the elementary school", or even the President of the United States making the same point in an official communication to the Congress.[12]

Looking back it becomes easier to see that we have been traveling along this road for some time. Financial support for guidance on a federal level has been available since 1938 when the Commissioner of Education ruled that Smith-Hughes and George-Dean funds could be used for partial support of state supervision of guidance services. However, support for guidance in the Office of Education has been something less than constant as is revealed by the abolition of the then Occupational Information and Guidance Service in 1952 and its re-establishment only under considerable pressure from APGA and APA. It is hardly possible to recognize the unit these days (now the Guidance and Counseling Program Branch) in terms of its growth in staff, added responsibilities, and presumable influence.

Legislation affecting veterans benefits in a federal, centralized, program operated in a countrywide network of regional offices and university guidance centers reveals a straight line progression with respect to counseling requirements. In 1943 in the Vocational Rehabilitation Act (for service-connected veterans) the need for vocational counseling was inferred. In successive laws, the GI Bill, the rehabilitation legislation for veterans of the Korea Conflict, and the War Orphans Educational Assistance Act, reference to vocational counseling became more and more explicit and direct. In the last law cited, educational and vocational counseling is mandatory but with considerable wisdom the counselee is not required to follow the counselor's recommendations.

More recent legislation is better known and brings us up to date. Starting with the provisions of the National Defense Education Act in 1958, the country has seen three other major legislative programs in all of which guidance and counseling not only is firmly embodied but which hold out implicit requirements for performance that now and again lead to unease. These are the Manpower Development and Training Act in 1961, the Vocational Education Act of 1963, and the staggering billion dollar Economic Opportunity Act of 1964.

The uneasy question is whether we can meet these responsibilities or whether we will be so spread that only a picture-thin veneer can be supplied. The problem is no longer one of getting a few more counselors in the program, nor how we can spread existing personnel, but how to train sufficient staff quickly and adequately enough so that the job given us can be done. We talk here not of some additional hundreds of counselors, but literally of thousands, and more probably of tens of thousands. An additional 32,000 full-time counselors are estimated to be needed between 1964 and 1967. Can this possibly be done?

The lightning has struck four times in two decades. In the 1940's and 1950's counseling was identified and liberally supported in veterans legislation. In 1954, the provisions of the Vocational Rehabilitation Act carried extensive provisions for rehabilitation counseling including the training of such personnel. In 1958, the National Defense Education Act provided budget for the enrichment of guidance services in the schools throughout the country and for the wholesale training of school counselors. Presently and inevitably the state-federal employment system must be looked to for important services on a very wide scale. There are reiterated references to the need for great changes in the United States Employment Service[21,12,1,16] including "increased numbers of better trained and more competent employment counselors . . ." Qualifications would have to be raised as would salary levels. The burdens to be carried by the USES are enormous and all in counseling will observe with all possible interest just what does happen. No doubt there are sharp limits on what money can accomplish; the training and development of staff, however, is not one of these.

The charge given to the USES reflects the new responsibilities of all in guidance and counseling. As indicated in the new laws and official reports, there is need to provide counseling service not only to those in school, from the elementary school up, but to dropouts, young unemployed workers, those seeking training and those who do not, minority group members, displaced workers, the disabled, draft rejectees, those confronted with the apparently inevitable need to change work, and older persons. This is not a prospectus from the profession but a charter from the government. What is really startling is that the checkbook has been brought out.

Counselors are an articulate tribe and we have held out the promise of answers. Can we deliver? There is more than the discomfort of unkept promises involved here. At a number of points, policy makers seem to base their estimates of changes to be brought about—he ability to meet national needs—on availability and high quality of guidance and counseling services. If for understandable reasons we are professionally inebriated, this is or should be a sobering thought.

And the Urgent Need for Self Examination

We are not the neutral agents that will help smooth the way toward a new work structure, a highly trained labor force, a different society, a changed set of values and a way of life that is not the same as it has been. We are ourselves subject to these changes; we will be far from untouched.

Our own procedures in our own calling are not so immutable as to be outside investigation, and the impulse had best come from ourselves. Hull's 1928 machine or no, the computer may pattern data for us about the individual in vocational choice that just may be superior to our work. The value commitments we cherish no doubt will change with society's changing value orientation; a specific one may be the sanctity of work as such. The two-person relationship may or may not emerge as God-given; we should be ready to explore other possibilities, especially since we may have little choice about it. The neat and compartmentalized formulations we cherish about the discrete steps in vocational choice as embodied in the set definition, even if modified to include Super's points, may prove to be quite inadequate.* The necessary procedure, always subject to change, may provide a number of services concurrently as the client requires them. Service will not stop when a job is obtained but rather is likely to be continuous through various job changes at various times in a working life. The paths for an individual to follow, preparation, work, further training, different work, may be different one from another. At later stages, work and non-work may be seen to constitute a continuum, the various facets of which are as subject to examination and evaluation of choices for an individual as is any one part of it.

There is as much promise as threat for the future of our work. Within limits, perhaps we can affect and even make our reality. This is a superb *chance* for our work, which really is all anyone can ask.

*I am indebted to Marguerite Coleman's thinking on this point in her paper given at the 43rd Annual Meeting of the Vocational Advisory Service, May 21, 1964.

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